C&A

The Mysore Agricultural Journal

(The Organ of the Mysore Agricultural and Experimental Union)

Vol. XXXI] January—March 1956 [No. 1

COMMONWEALTH INST. OF ENTOMOLOGY LIBRARY
26 JUN 1956
SERIAL As. 6
SEPARATE

IN THIS ISSUE

MANURING OF ARECA PALM

LARVAL PARASITES OF *LABLAB* POD-BORER

MERITS OF JAPANESE METHOD OF PADDY CULTIVATION

EXPERIMENTS WITH SYSTEMIC INSECTICIDES

DAHLIA

HAZARDS OF MODERN INSECTICIDES

POTATO CULTIVATION IN CHIKBALLAPUR

The
Mysore Agricultural Journal

**(Organ of the Mysore Agricultural and Experimental Union
Cenotaph Road, Bangalore-2**

Vol. XXXI January to March 1956 No. 1

M. MALLARAJ URS, B.Sc., B.Sc. (EDIN.), Director of Agriculture, *President.*

V. MASIYAPPA, B.A., LL.B., *Vice-President.*

K. V. BYRE GOWDA, *Hon. Secretary.*

M. NARAYANAPPA, L.AG., *Secretary.*

Editor : M. L. N. IYENGAR.

Published quarterly. Copies are obtainable from the Secretary at Re. 1-8-0 per copy or by subscription at Rs. 6 a year. Non-editorial correspondence should be addressed to the Secretary. Editorial communications, new exchanges and books for review, may be addressed to the Editor, MYSORE AGRICULTURAL JOURNAL, *Department of Agriculture, Seshadri Road, Bangalore-1.*

(The Mysore Agricultural and Experimental Union does not accept responsibility for facts or opinions expressed by contributors.)

CONTENTS

	PAGE
EDITORIAL	1
Dr. L. C. Coleman, M.A., Ph.D.—An Appreciation—BY DR. M. PUTTARUDRIAH	3
Gliricidia maculata *H. B. & K.*—BY M. L. N. IYENGAR ..	5
Manuring of the Areca Palm—BY DR. B. NARASIMHA IYENGAR	14

PAGE

A Note on the Larval Parasites of the Lablab *Pod-Borer* (Adisura atkinsoni *Moore*)—By Dr. M. Puttarudriah and G. P. Channa Basavanna 28

The Merits of the Japanese Method of Paddy Cultivation Compared with the Local Methods under Mysore Conditions—By Dr. S. V. Govindarajan and H. G. Gopala Rao 32

A Note on the Results of Experiments with Systemic Insecticides—By Dr. M. Puttarudriah 37

Dahlia—By M. R. Anandaramiah 40

The Hazards of Modern Insecticides—By Dr. M. Puttarudriah and B. M. Maheshwariah 50

Potato Cultivation in Chikballapur Area—By K. Ranganatha Rao 55

CORRESPONDENCE

A Virus-Like Disease of Some Economic Plants in Mysore By Dr. M. Puttarudriah and S. Usman 62

APOLOGY

Owing to causes beyond our control, the Mysore Agricultural Journal *could not be issued during* 1955. *We apologise to the subscribers and readers for this inconvenience.*

FAREWELL AND WELCOME

We bid farewell to Sri. M. K. Appajappa, B.A., I.A.S., who relinquished his office as President of the Mysore Agricultural and Experimental Union, on his transfer as Commissioner for Local Self-Government on 23-5-1955.

Sri. Appajappa had, during his tenure as President, endeared himself to a large body of members of our Union by his affability, earnestness and urbanity. He had made it his special duty to meet our members during his extensive tours in the districts, to understand their needs and problems first hand and to present to them the policies and programmes of the State Department of Agriculture in simple, homely and convincing style. The success of the campaign for "Japanese Method of Paddy Cultivation" in Mysore owes much to Sri. Appajappa and his personal and administrative qualities.

SRI. M. K. APPAJAPPA, B.A., I.A.S.

We welcome our new President, Sri. M. Mallaraj Urs, B.Sc., B.Sc. (Edin.). Sri. Mallaraj Urs brings to his new task the great gifts of youth, enthusiasm, friendship, method and tenacity of purpose—qualities essential for a successful administrator in a Welfare State. His friendliness and prowess as

a sportsman—he was an excellent hockey player, made him a popular figure both on the fields and in the classrooms of the Central College from where he graduated. After qualifying himself in agriculture at the University of Edinburgh, he joined the Mysore Department of Agriculture as Assistant Director. He has served the State in various capacities—Assistant Director, Food Supplies ; Secretary, Committee for Agriculture of the Mysore Economic Conference ; Officer I/C. of the Grow More Food Campaign ; Principal, Agricultural College ; and

SRI. M. MALLARAJ URS, B.Sc., B.Sc. (EDIN.).

Deputy Director of Agriculture. Before assuming the present office as Director of Agriculture, he travelled widely in the United States and undertook intensive studies in the State College of Washington. With his qualities of head and heart and his wide experience in various fields, he will, it is hoped, make a great success of his stewardship of the Department of Agriculture and of his office as President of our Union.

DR. L. C. COLEMAN, M.A., Ph.D.
AN APPRECIATION

By Dr. M. Puttarudriah*

Agriculturists in general and entomologists in particular in India were grieved to hear the sad news of the demise of Dr. Leslie C. Coleman (May Peace be on his soul!) by an accident in his native country on 14th September 1954. Dr. Coleman was one of the pioneers in the field of Agricultural Entomology in India. Having started his career as Entomologist and Mycologist to the Government of Mysore in 1908, he made many outstanding contributions on our major crop pests. He built up the Division of Entomology on a sound basis and for the first time, worked out the biology and control measures of serious pests like the paddy and *jola* grasshoppers, hairy caterpillars, green bug on coffee and many other pests. A great collection of pests was built up and intensive research was undertaken. Many insects were described for the first time and many were named after him.

He has been immortalised more than once, as several insects named after him bear witness. An entire genus was erected as *Colemania* Bolivar with the species *Sphenaroides* Bolivar as this serious pest of *jowar* called the Deccan Grasshopper was discovered and worked out in the northern districts of Mysore by him.

Apart from his contributions to the study of the paddy grasshopper, another new species of grasshopper found in paddy fields has been named after him as *Hieroceryx Colemani* Bolivar.

His name has been a household word among coffee planters. He has saved their coffee industry from the ravages of not only *Koleroga* but also of green bug which again was worked out by him and so was named after him as *Coccus (-Lecanium) viridis Colemani* Kannan.

Even in the early days of his entomological career, he realised the importance of the beneficial natural agency in keeping the pest below economic level. He noted many hymenop-

* Head of the Division of Entomology, Mysore State Department of Agriculture.

terous parasites on crop pests and as many as six of them have been named after him : *Aphidius Colemani* Viereck, *Apanteles Colemani* Viereck, *Anastatus Colemani* Crawford, *Bruchobius (Sphœrakis) Colemani* Crawford, *Tetrastichus Colemani* Crawford and *Telenomus Colemani* Crawford.

During 1921 and 1933, he tried to introduce the lantana *Agromyzid* flies from Hawaii for the biological control of the introduced weed *Lantana camara*, which has become a serious scourge in this country.

His contribution in other fields of agriculture have been many and in the field of entomology his works on "The Rice Grasshopper", "The *Jola* or Deccan Grasshopper", "Hairy Caterpillars (*kamblihulas*) in Mysore", "Some Scale Insect Pests of Coffee in South India"; "Ground Beetles Attacking Crops in Mysore", together with his "Notes on Sugarcane Cultivation in Java", "Report on the Coffee Berry-Borer in Java", and "Improvement of Coffee in the Dutch East Indies", etc., etc., have been outstanding.

In a small space, it is very difficult to express adequately the unforgettable contributions to the cause of the Mysore farmer and the small homage that a student of entomology can pay to the memory of the great scientist is to state that the foundation he laid in the Division of Entomology is secure and strong and the work that he did will sustain his successors to build up the fortress of teaching, research and plant protection that he aimed at. In fact, it is gratifying to state here that when he visited this country during 1953-54, he expressed his great satisfaction about this Division and hoped that he would come again after another interval to review the work here and note his satisfaction; but God willed it otherwise.

Dr. L. C. Coleman is a name which inspires all entomological workers and we in this Division hope to continue the work for the cause of cultivators he stood for.

EDITORIAL ARTICLE

GLIRICIDIA MACULATA H. B. & K.

By M. L. N. Iyengar

The Mysore State Department of Agriculture organised a '*Gliricidia* Week' during August 1955 to acquaint the farmers, particularly the paddy growers, with the possibilities and potentialities of this tree green manure.

The paddy farmers in the old channel areas of Mysore and Hassan are quite familiar with the benefits of green manure raised *in situ* on paddy fields. Many cultivators in this region regularly sow sannhemp with greengram, blackgram and gingelly, after the April showers. But green leaf manuring is not so well known. On the other hand, in Kolar and Tumkur Districts, where paddy is grown under tanks and wells and in the *Malnad* where it is grown by impounding the heavy rainfall, green leaf manuring is quite a common practice. In the dry districts, the principal source of green leaf manuring is *Hongey* (*Pongamia pinnata*). In other areas, *Cassia fistula* (ಕಕ್ಕೆ), *Indigofera asplathoides* (ಕೊಗ್ಗೆ), Neem *Azadirachta indica* (ಬೇವು), *Cassia auriculata* (ತಂಗಡಿ, ಆವರಿಕೆ), provide green matter. Wild shrubs like *Calotropis gigantea* (ಎಕ್ಕ), *Lantana camara* (ಲಾಂಟಾನ) and wild creepers like *Lettsomia elliptica* (ಉಗಣಿಹಂಬು), *Argyeria cuneata* (ಅಚ್ಚಾರಿಗಿಡ, ಕಳ್ಳನಹಂಬು) also provide green leaf and twigs.

It is evident from the foregoing that green manuring in one form or another, particularly for the paddy lands, is practised in many parts of the State. It may therefore appear superfluous to organise a campaign for popularising *Gliricidia maculata* but in fact, it is not.

Sannhemp is sown in the channel districts along with greengram, blackgram, and gingelly but the *raiyats* cannot resist the temptation to harvest a catch crop of pulses and oilseeds and the only green matter that is actually incorporated into the soil is sannhemp which forms roughly one-fourth of the mixture. Trials at the Agricultural Research Station, Nagenahalli, have shown that 30 seers of a mixture of sannhemp, cowpea and horsegram in equal proportions gives fairly heavy

yields of green matter. This combination is designed to ensure a fairly successful crop of green manure. If weather conditions are unfavourable, at least horsegram which is more drought-resistant will yield some green matter. If the moisture conditions are too high for sannhemp, cowpea will yield a good crop. When conditions are quite optimum, sannhemp grows luxuriantly with an undercover of horsegram. In spite of the patent advantages of this mixture, few *raiyats* have adopted it mainly because it does not give them a catch crop of pulses, etc., as in their usual mixture. It is therefore necessary to introduce into these regions a tree green manure, the loppings of which may supplement the meagre green material that is obtained from the *raiyat's* practice. *Gliricidia* would, to use an American idiom, fill the bill satisfactorily.

In areas where *hongey* leaf manuring is practised as in Kolar, it may be thought that *Gliricidia* has no place. The *hongey* is a very valuable and multi-purpose tree. In addition to yielding easily decomposable leaves and twigs for the paddy lands, its rich blossom fall makes a very valuable and prized manure for sugarcane and garden crops. Its pods give an excellent non-edible oil which is used as an illuminant. The oil-cake is sought after by sugarcane-growers and gardeners on account of its repellance to red ants. The wood makes a good fuel and is also used in construction of temporary farm structures. But its chief disadvantages as a source of green matter are: (1) It takes too long to establish and be ready for loppings, (2) It yields one or at best two loppings an year, (3) The proportion of twigs, branches and other woody matter in the loppings is comparatively high, (4) It cannot be raised on bunds or very near fields on account of its dense shade and interference with the crop underneath and it has therefore, to be transported from some distance, and (5) Although it yields fairly succulent green matter in June-July for the monsoon crop of paddy, it will be almost bereft of its foliage in February-March and the problem of green leaf manuring the summer paddy crop becomes well nigh impossible.

Gliricidia maculata, on the other hand, suffers from none of these disadvantages. The plant can establish itself in 2-3 years and reach maturity in its 5th or 6th year. It attains a height of 6-8′ in about 3 years and yields thereafter about 50 lb. of soft, easily decomposable green material per tree. A mature tree can yield 200 lb. At the A.R.S. Aduthurai, a single plant

is reported to have yielded as much as 300 lb. of green matter in its third year. Once established, it needs very little attention thereafter. The tree can live for 20 years even though it is regarded that the economic life of the tree is 8-12 years.

Lopping may be commenced even an year after planting. In fact, it is necessary to lop the first growth fairly early to prevent the tree from becoming top heavy and being blown down. The plant can stand frequent loppings. Generally, two loppings are taken per year. At suitable elevations, even 4 loppings are taken in Ceylon. In one estate in that country, even 6 loppnigs were practised. It is stated that severest lopping can be employed without fear of damage. Such frequent loppings have many clear advantages. If *Gliricidia* is kept regularly lopped, the danger from pests is greatly diminished. It can yield green matter both for the monsoon and the summer paddy crop. By frequent loppings, a greater amount of easily decomposable green matter and a lesser amount of woody stems is obtained. From experiments conducted in Ceylon, it has been found that after the 5th or 6th month, the "direct effects of green manuring from the nitrogen standpoint are hardly appreciable". It is, therefore, preferable to green manure at shorter intervals and in smaller quantities than at longer intervals and with larger amounts. This becomes possible in the case of *Gliricidia*. It has been found that the optimum time for lopping of *Gliricidia* is when the growth is 3 months old. That means frequent lopping is necessary to get a supply of easily decomposable green matter.

Gliricidia, unlike the *hongey*, can be raised on or near the fields either as plants on the broad bunds or as fence or hedge round fields. It can be planted on field borders, waste lands, village commons or around manure and compost yards. If grown very near or on crop lands, the density of shade can be reduced by lopping. It is estimated that an acre of paddy field divided into 10 terraces of 10 cents or 2½ *guntas* will have about 500 yards of bunds. In the channel regions and in *malnad*, the number of terraces per acre will be much more and the bunds will be narrow, meant only to impound water. There may not be enough broad bunds in such areas for planting *Gliricidia*. In several paddy fields, however, it may not be difficult to secure about 250 yards of broad bunds. In such fields, Gliricidia could be planted 6-7½′ apart to secure a stand of 100-125 plants. After 2 years, they may yield on an average 50 lb. of green matter or about 5,000-7,500 lb. of green leaf

manure enough for an acre of paddy. If grown in or near the fields, the loading, unloading and transport charges, inevitable and high in the case of *hongey*, can be saved.

As stated earlier, *Gliricidia* can be planted for a variety of purposes. It is an ornamental tree with elegant feathery foliage attaining a height of 30-40′. In Lal-Baugh at Bangalore, there is a huge tree which was planted over 50 years ago. It can be grown as a shrub, fence or hedge. For the latter purpose, cuttings are planted in 3 rows close to one another, both in the row and between rows. It is employed as a shade tree in tea estates, and sometimes in coffee and cocoa estates in Indonesia, Malaya, Indo-China, Ceylon, Uganda, Zanzibar, West Indies and Venezuela. But as it sheds its leaves in summer, it has its limitations as a shade tree. In the tea estates, it has another advantage. The growth of such trees as *Gliricidia* and dadap, in addition to improving the drainage and aeration of the soil, enables the roots of the main crop to penetrate deeper into the subsoil. It serves as a windbreak in wind swept regions and fields, if planted close to one another.

Although it is reported from Ceylon that "neither cattle, goats nor sambhur eat the leaves of *Gliricidia*", in Malaya, the foliage is fed to cattle.[1] In Trinidad, it is planted as a browse plant in pastures. In British West Indies it is stated to be palatable to cattle and other livestock and is planted as a low hedge of 3-4′ around grass fields to provide "protein-rich foliage". For this purpose it is trimmed at intervals of 6-8 weeks. The leaves are fed either fresh or dried and ground to a meal containing about 22 per cent. protein. Since paddy fields in our country become the congregating grounds for all village cattle after harvest, the wisdom of planting *Gliricidia* in such fields may be questioned. But it is the experience in Madras that, if planted early, by the time paddy is harvested, the plant may grow to a height beyond the reach of goats and cattle. All the same, it would be prudent to provide some temporary tree guards to prevent damage to the young trees.

Another advantage in favour of *Gliricidia* compared with *hongey* is the ease with which it can be propagated. The *hongey* is generally propagated by planting the large seeds in prepared pits. Sometimes, nurseries are raised and seedlings transplanted. Cuttings can be rooted but the success attend-

[1] The composition of *Gliricidia* is given on p. 10.

ing the operation is uncertain. On the other hand, the propagation of *Gliricidia* is very easy. A pound of seed contains about 6,000[2] seeds and nearly 70 per cent. of them are viable. Seeds are sown in a nursery and although in 2-3 weeks they can be transplanted, are kept on for 10-12 weeks. It is better to sow the seeds thinly so that when planting out, each seedling may be removed with a ball of earth surrounding the roots. Pits 10" deep are prepared, filled with manure and earth, watered well and planted. The plants are watered thereafter whenever necessary. The seeds may be sown in April-May and planted out in July-August after the monsoon has established itself. The cost per pound of seed is generally Rs. 5. If planted on the broad bunds, about 180 seeds costing $2\frac{1}{2}$ annas will be required per acre. Propagation by cuttings is also easy. Short cuttings of about 3' are planted in a slanting manner. The Ceylon Department of Agriculture, however, recommend long vertical cuttings of about 6' as they shoot more readily from the top and produce trees of desirable shape more quickly. In some estates in Ceylon, the ends of cuttings are dipped in some water-proof material but this is regarded as unnecessary. Where a grove or *tope* is to be planted as on village commons, waste lands, etc., the plants may be spaced $12' \times 12'$.

Like *hongey*, *Gliricidia* is a good source of nectar. The flowering commences in December and continues upto March. The blossom opens between 3 and 5 p.m., and remains open for 3-4 days. Little or no nectar is present on the first day, but the secretion increases on the following days. The bees visit the flowers throughout the day but are specially active in the forenoon between 10 a.m. and 12 noon. The honey from *Gliricidia* is red yellow in colour with an agreeable and mild aroma.

As a source of nitrogen, it compares favourably with *hongey* and many other green manures. The percentage composition of *Gliricidia* and other tree and shrub green manures is given in Table I. It will be seen that *Gliricidia* is not inferior to *honge* in this respect. The flowers of *honge*, as mentioned earlier, are very much prized for vegetable gardens. The flowers of *Gliricidia* are equally rich containing as they do 3·36 per cent. of nitrogen.

In regard to decomposability of green matter in the soil Sanyasi Raju gives the following descending order of decom-

[2] In *Legumes in Agriculture* (FAO), the number is given as 3,000.

TABLE I

Percentage composition of fresh green leaves and twigs of some tree and shrub green manures

		Nitrogen	Phosphoric acid	Potash	Lime
1	*Hongey. Pongamia pinnata*—				
	Leaves ..	1·16	0·14	0·49	1·54
	Twigs ..	0·71	0·11	0·62	1·58
2	*Thangadi. Cassia auriculata*—				
	Leaves ..	0·98	0·12	0·67	1·06
	Twigs ..	0·75	0·06	0·36	0·41
3	*Yekka. Calotropis gigantea*—				
	Leaves ..	0·42	0·12	0·37	0·20
	Twigs ..	0·22	0·09	..	..
4	*Lantana. Lantana camara* ..	0·88	0·15	0·90	0·61
5	*Ugani hambu. Lettsomia elliptica* ..	0·63	0·14	0·47	0·80
6	Sannhemp. *Crotalaria juncea* ..	0·75	0·12	0·51	0·39
7	Cowpea. *Vigna catjang* ..	0·75	0·15	0·58	0·64
8	Greengram. *Phaseolus radiatus* ..	0·72	0·18	0·53	0·76
9	Blackgram. *Phaseolus mungo* ..	0·85	0·18	0·53	0·74
10	*Gliricidia maculata*—				
	Leaves and tender stem ..	0·79	0·19	0·37	0·77
	Stems and older branches ..	0·39	0·07	0·19	0·20

N.B.—1 to 9 Coleman *et al.*, *Green Manuring in Mysore*, pp. 6 and 9.
10 from *A Manual of Green Manuring*, p. 13.

posability for some of the tree and shrub green manures from uncropped lands.

Calotropis, *Gliricidia*, *Hongey*, *Cassia*, *Croton sparsiflorus* (ಭೇದಿಸೊಪ್ಪು), *Delonix* (ನಾತನಾರಾಯಣ). *Thespesia* (ಹೂವರಿಸಿ), Datura and *Sesbania speciosa*.

In Table II is given the maximum nitrate accumulation or nitrification in the soil resulting from application of different green manures.

TABLE II

Nitrate accumulation or nitrification in the soil from green manuring

Treatment / Date of analysis :		Moisture on green material %	Nitrogen on material at 100° C.	Mgm. nitrate or nitrite nitrogen per 100 gm. dry soil														Max. % nitrified
				4-12-1925	18-12-1925	4-1-1926	18-1-1926	1-2-1926	15-2-1926	3-3-1926	16-3-1926	30-3-1926	12-4-1926	26-4-1926	10-5-1926	25-5-1926	4-6-1926	22-6-1926	
Gliricidia	Lab.			·61	1·11	3·48	7·82	8·96	2·20										43·7
do	Field	58·7	3·63	·63	·47	4·72	14·14	4·76	7·58	8·10	3·55	8·82	1·82	2·91	·95	..	·86	·67	86·3
Dadap	Lab.				2·28	4·36	9·60	7·93	5·99										68·6
do	Field	76·2	4·39	..	1·01	5·62	14·46	5·26	7·88	10·26	3·02	7·68	2·55	2·88	·53	..	·62	·15	126·4
Crotalaria	Lab.				2·60	5·54	13·20	12·40	8·20										77·7
do	Field	61·2	4·32	..	·96	6·26	10·99	4·28	5·33	7·61	4·78	9·07	1·88	3·44	·95	..	·35	·80	70·5
Tephrosia	Lab.				3·23	5·09	14·40	14·20	8·19										60·0
do	Field	54·5	4·53	..	·56	4·26	9·46	4·93	6·91	7·91	4·94	8·63	1·63	4·00	·43	..	·87	·66	40·2
Cattle Manure	Lab.				1·54	1·76	2·48	3·17	2·22										27·5
do	Field	65·0	·81	..	2·50	2·81	2·78	1·98	2·27	1·71	1·13	3·50	1·10	1·50	·30	·68	·29	·25	57·9
Control	Lab.				·60	1·58	2·42	2·40	2·28										
do	Field	..	..	..	·41	1·00	1·19	1·00	1·74	1·81	·91	1·03	1·04	1·10	·37	·63	·19	·23	..

Lab. = Green Manure Laboratory Experiment Result. Field = Green Manure Field Experiment Result. (From *A Manual of Green Manuring*, Ceylon Dept. Agric., pp. 19 and 20.)

From this table it will be clear that nitrate nitrogen per 100 g. of dry soil reaches the maximum nearly 2 months after application and in this respect it is slower than *Crotalaria* and *Tephrosia* in the laboratory though not in the fields. Comparable figures for *hongey* are not available.

Gliricidia is fairly free from diseases and pests but all the same it would be prudent to be on the look out for any outbreaks of the following : Brown root disease due to *Fomes lamaœnsis* Murr, *Sphœrostilbe repens* B. & Br., *Ustulina zonata* Lev, the pink disease due to *Corticium salmonicolor* B. & Br., aphids (*Aphis gossypii*) on tender shoots causing a distortion and curling of young leaves, mealy bugs (*Pseudococcus virgatus* and *P. citri*) and the green bug of coffee, *Coccus viridi* which have all been recorded in Ceylon.

From the foregoing, it will be seen that *Gliricidia* is, in many ways, as useful a plant to the agriculturists, both in the channel districts and elsewhere as the *hongey* from the standpoint of their manurial requirements. This does not mean that it can replace *hongey*. *Hongey* has its own special place in the agricultural economy of Mysore and should be planted wherever and whenever possible. Pending establishment of such plants or where *hongey* cannot be raised easily or without much expense, *Gliricidia* may be planted. Instead of supplanting, *Gliricidia* should supplement *hongey*.

Gliricidia belongs to the natural order Leguminosæ. The genus comprises of 6-8 species and is found in Cuba and South America. There is some disagreement as to when this tree was introduced into India. Mr. Edmonds, the then Deputy Director of Agriculture, Madras, obtained some seeds of *Gliricidia* from Ceylon and sowed them at the Agricultural Research Station, Hagari, on 23-7-1935. But Cameron seems to have introduced it into Bangalore long before. There is a large tree in Lal-baugh which was planted at the end of the last century and given the wrong name of *Lonchocarpus*. There is another tree which is also fairly big, planted a few years later. Gokhale and Habbu mention it in their Bulletin published in 1927. Mr. Edmonds' therefore appears to be a third or later introduction to southern India.

The views of the members of the Mysore Agricultural and Experimental Union in regard to the merits and demerits of both *Hongey* and *Gliricidia* are invited.

References

——— (1951), *Krishikar Bandhu*, 3, 5-6, 12.

——— (1952), "*Gliricidia maculata*—A Good Source of Nectar", *Madras Agric. J.*, 10 (5), 35.

Coleman, L. C., Iyengar, B. N. and Sampatiengar, N. (1912), "Green Manuring in Mysore", *Mysore State Dep. Agric. Bull. Gen. Ser.*, 1.

Dep. Agric. (Ceylon) (1931), *A Manual of Green Manuring.*

Gokhale, V. G. and Habbu, V. S. (1927), "Trees and Shrubs for Producing Green Manure in the Konkan and North Canara", *Bombay Dep. Agric. Bull.*, 141, 27.

Kanti Raj, M. (1950), "Green Leaf Manuring and Green Manuring", *Madras Agric. J.*, 37 (1), 3-6.

Sanyasi Raju, M. (1952), "The Role of Organic Manures and Inorganic Fertiliser in Soil Fertility", *Madras Agric. J.*, 39 (3), 137.

Whyte, *et al.* (1953), "Legumes in Agriculture", *F.A.O. Agric. Studies* No. 21, 274-75.

MANURING OF THE ARECA PALM

By Dr. B. Narasimha Iyengar*

The local practice of manuring the areca palm in the *Malnad* or highlands of Mysore is described in detail on pages 10 and 11 of *The Cultivation of the Areca Palm in Mysore*,† by Leslie C. Coleman and M. K. Venkata Rao. Experiments with artificial manures were started on the now defunct Marthur Farm in 1920 by me as agricultural chemist and continued for over 15 years. Two short accounts of the work done from 1920 to 1927 have already been published in *The Journal of the Mysore Agricultural and Experimental Union* (Volume V, No. 2, pages 85-87; and Volume 9, No. 1, pages 8 to 11). Since research on areca has now been taken up on an all-India basis, the results of work done in Mysore on manuring are now put together to serve as a basis for further investigation of all problems on manuring in the newly established research station near Thirthahalli, Shimoga District.

Ever since work was started in 1920, the whole garden was given a dressing of farmyard manure at 10-20 lb. per tree every year according to the quantity available on the farm, unless otherwise mentioned, and covered over with green leaves and twigs according to local practice.

The whole garden, about 4 acres in extent, and containing about 1,200 trees per acre of all ages, was divided into strips along the 100 rows of trees for different manurial treatments. Each of the variously treated strips had at least 2 rows of trees and there was a check strip after every two stirps getting artificial manures. Each manurial treatment was repeated on two different strips at least.

The various plant-foods were supplied at the following doses per tree :

Nitrogen at 0·25 lb. as 3 lb. of groundnut oilcake or 1·25 lb. of sulphate of ammonia.

---

* Retired Director of Agriculture in Mysore.

† Mysore State Department of Agriculture General Series, Bulletin No. 10 (1918).

Phosphoric acid at 1 lb. as 7 lb. superphosphate.

Potash at 0·2 lb. as 0·5 lb. sulphate of potash.

The manures were applied either singly or in suitable combinations according to plan of experiments. They were well mixed with the soil round each tree a little distance away from the base to a depth of about 6". About a couple of weeks after the application of artificials, cattle manure was applied and the whole thing was covered over with green leaves and twigs according to the usual local practice.

Manures were applied for the first time in December 1920, and later on in October-November of every year after the main harvest. As the garden had not been manured at all since 1917, it was manured for 3 years continuously to bring it into good condition as soon as possible. All agricultural operations, such as digging, trenching, weeding, etc., were under the direct control and supervision of the agricultural staff attached to the farm. The application of manures and harvest operations were supervised by a Senior Assistant Chemist from the Chemical Section of the Department. The Plant Pathology Section kept the garden free from *Koleroga* by spraying it with Bordeaux mixture.

To keep an accurate account of the crop from every tree, all rows and trees in each row were permanently numbered. The weight of green nuts from every tree at each harvest was recorded in a register. The whole crop was then mixed together, shelled, sliced, boiled, coloured and dried to suit the market according to local practice. The ratio of finished produce to the weight of green nuts was determined and the yield was calculated for every treatment. According to local practice and experience, though each acre contains 1,200 trees of all ages, only 400 of them are considered to be in bearing. The yield of dry nuts was calculated on the basis of 400 yielding trees per acre. As every tree was numbered and its yields of green nuts was entered in the registers separately, it is quite possible to determine the yield of every tree year by year and according to its age as well.

The first series of experiments was intended to find out the requirements of the areca palm with regard to three important plant-foods—nitrogen, phosphoric acid and potash. The plan of the experiments as well as crop yields of every year are given in Table I and only average figures for 3 seasons for each treatment are given below.

Treatment 1921–23	Average yield lb. per acre	Increase % over check
Check or no artificials ..	590	..
Groundnut cake ..	757	28
Cake and super ..	733	24
Cake, super and potash ..	904	52
Ammonium sulphate ..	778	30
Sulphate and super ..	760	29
Sulphate, super and potash ..	803	36

It has already been stated that rows of trees were grouped into strips for each treatment. The number of trees that were harvested under each treatment during the first three years is given below.

Treatment	No. of trees harvested		
	1921	1922	1923
Check ..	733	820	773
Cake only ..	121	131	121
Cake and super ..	164	190	174
Cake, super and potash ..	144	166	150
Ammonium sulphate ..	123	132	118
Am. sulphate and super ..	153	161	156
Am. sulphate, super and potash ..	143	161	157
Total ..	1,581	1,761	1,649

It is seen from the above figures that about 50% of the trees harvested in each year had not received any artificial manures. About 100 trees at least under each treatment have yielded crop. Even during the first year, about 400 trees per acre have given crop, while their number is nearly 450 in the second year. As will be seen later on, experiments in one form or other were conducted for 16 years from 1920 to 1936, but the number of trees harvested each year has not been compiled, though they have been recorded in the register kept for the purpose.

The yield of 590 lb. or slightly over 20 md. per acre from the check series represents the average yield for the Shimoga District, the locality in which the farm was situated, as given on page 2 of the Bulletin already referred to. The percentage increases of crop over the check series due to the addition of one or more plant-foods is also given in the above statement.

The maximum average yield of 904 lb. per acre of 400 bearing trees during the period has been from the series manured

TABLE I

Treatment and annual yields from 1921 to 1926

Treatment 1921–23	Yield of dry nuts in lb. per acre								Treatment 1924–26
	1921	1922	1923	1921–23 Average	1924–26 Average	1924	1925	1926	
Check ..	569	535	780	628	800	765	748	888	Ammonium sulphate and potash
do ..	448	406	578	518	767	643	804	854	Sulphate, super and potash
do ..	612	540	713	620	786	707	710	950	Cake and potash
do ..	528	490	731	588	787	681	764	900	
Groundnut cake ..	730	686	856	757	774	756	726	840	Residual effects of manures obtained during 1921–23
Cake+Super ..	650	697	852	733	762	802	663	821	
Cake, super and potash ..	948	822	942	904	941	988	762	1,073	
Sulphate of ammonia ..	787	697	850	778	713	716	655	769	
Sulphate of ammonia and super ..	727	728	825	760	700	664	659	777	
Sulphate of ammonia, super and potash	803	749	856	830	807	896	660	865	

N.B.—Figures are given for an acre containing 400 bearing trees. Manures are applied at the rate of :—

0·25 lb. N per tree or 100 lb. per acre as cake or ammonium sulphate.
1·0 lb. P_2O_5 do or 400 lb. do as superphosphate.
0·2 lb. K_2O do or 80 lb. do as sulphate of potash.

with cake, super and potash and represents an increase of more than 50% over the check series. The effects of potash are clearly seen in the cake series but not in the sulphate of ammonia series. The simultaneous application of all plant-foods in a soluble form in the sulphate series may have brought about some undesirable changes in the concentration of the soil solution making it difficult for the plant to properly assimilate the materials needed. The point can only be cleared up by the application of sulphate of ammonia some time after application of the other two manures. From figures given above, it is seen that in both the series of experiments the addition of superphosphate alone to either cake or sulphate of ammonia has not contributed to any increase in yield. In order to find out the necessity or otherwise of phosphoric manures, the experiments were remodelled in 1924. The former check series were manured as detailed in Table I, and the manured rows were left unmanured to study the residual effects of manures applied for 3 years continuously.

The detailed yields of the new series of experiments for the various years are also found in Table I, and only average yields of 3 seasons are given below.

Average yield lb. per acre 1921–23	Treatment during 1924–26	Average yield lb. per acre 1924–26
628	Am. sulphate and potash	800
518	Sulphate, super and potash	767
620	Cake and potash	786
588	Cake, super and potash	787

N.B.—During 1921–23, the rows were treated as checks.

The fertility of these rows is also indicated by their yields during 1921-23 when they received no artificial manures and were treated as checks. These variations in fertility may not be due to soil conditions alone, for all the rows do not contain trees of the same age. The presence of these two variable factors makes it rather difficult to accurately judge the effects of manures applied. Moreover as some trees which existed in the rows and were bearing during 1921-23 fell down due to heavy winds of the south-west monsoon each year and new young trees had also come into bearing in the meanwhile, the interpretation of results becomes much more difficult and complicated. As the harvest each year has been conducted tree by tree, it may be desirable to take the yields of only those trees which

have given a crop right through the peirod of experiments and interpret the results.

Neglecting the fertility figures for 1921-23 and judging only from the results of 1924-26, the necessity for adding phosphate to the manure mixture for areca is not quite clear. The main function of phosphoric acid in plant life being to stimulate growth of roots, uniform stand and ripening of crop, its necessity or otherwise cannot be judged from crop yields alone.

The mixture of cake, super and potash may be said to be very slightly better in its effects than the one containing sulphate of ammonia instead of oilcake. At any rate, the big difference of 100 lb. in yield in favour of the cake mixture during 1921-23 has dwindled down to 20 lb. during 1924-26. This may be due partly to the presence of very young trees bearing crop for the first time and also taking the place of mature trees falling down due to winds during the south-west monsoon.

Coming now to the residual effects of manures applied during 1921-23, the average yields during 1924-26 due to various treatments in previous years are given below :

Average yield lb. per acre 1921–23	Treatment during 1921–23	Average yield lb. per acre 1924–26
757	Groundnut cake	774
733	Cake and super	762
904	Cake, super and potash	941
778	Sulphate of ammonia	713
760	Sulphate and super	700
830	Sulphate, super and potash	807

N.B.—Yields for 1924–26 are due to residual effects of 1921–23.

It is seen from above figures that there has not been any falling off in yield in the cake mixture series and that it is still ahead of sulphate mixture series by 134 lb. or nearly 5 md. to the acre.

Hence it may safely be said that after a garden has been brought into a good yielding condition, the local practice of manuring it once in 3 years by rotation is a fairly sound one.

From 1921 to 1926, very heavy doses of the important plant-foods had been applied to get only an indication of their effects on crop yields. From 1927 onwards, new experiments were started to work out an economic dose of N, P and K consistent with good crop yields. Rows treated as checks in 1924-26 were taken up for new manurial trials and the manured rows in the

same period were left unmanured as checks to study residual effects of previous manuring.

The plan of experiments, details of manuring and crop yields for each year during 1927-32 together with average figures for the whole period as well as for the previous one are given in Table II. Details of manuring and average yields only are given below together with average yields for 1924-26 for comparison.

Average yield lb. per acre 1924–26	Treatment during 1927–32	Average yield lb. per acre 1927–32
774	100 N as cake, 400 P, as super and 100 K as sulphate	714
762	100 N as cake, 400 P and 200 K	682
941	100 N as cake, 150 P and 200 K	744
713	50 N as cake, 75 P and 100 K	786
700	100 N as nitrolim, 150 P and 200 K	736
807	100 N as am. sulphate, 150 P and 200 K	722

Taking the average yields for 1927-32 into consideration, it is seen that the highest yield of 786 lb. has been with the lowest quantities of manures applied—50 N as cake, 75 P and 100 K—and the lowest yield of 682 lb. from the maximum quantities of manures applied—100 N as cake, 400 P and 200 K. Comparing the 3 series in which 100 N has been applied in 3 different forms along with 150 P and 200 K, it is seen that oilcake as source of nitrogen has shown itself slightly better than either sulphate of ammonia or nitrolim.

The yields for 1924-26 given in the above statement are due to the residual effects of manures applied in 1921-23. Except in two instances, the yields for 1927-32 are lower than those for 1924-26. In one instance, the yield has fallen from 941 lb. to 744 lb. in spite of continuous manuring. This can only be attributed to very young trees beginning to give crop in place of good yielding ones which might have fallen down during monsoon winds. Whether it is a fact or not, can only be determined after a detailed examination of yields recorded tree by tree in the old registers.

A study of annual yields in all cases as given in Tables I and II, whether in the "manured series" or in the "residual effect series" of the three periods, 1921-23, 1924-26, 1927-32, reveals one strange fact which is, that the highest yields have generally been in the last year of the period. In the manured series at least, this may be attributed to the cumulative effect of manures

TABLE II

Treatment and annual yields from 1927 to 1932

Treatment during 1924–26	Yield in lb. of dry nuts per acre of 400 bearing trees								Treatment during 1927–32
	1924–26 Average	1927–32 Average	1927	1928	1929	1930	1931	1932	
Ammonium sulphate and potash ..	800	603	682	612	591	543	580	609	Residual effects of manures applied during 1924–26
do + Super ..	767	641	773	641	624	506	687	614	
Cake and potash ..	786	630	685	669	565	637	567	659	do
do + Super ..	787	676	778	643	630	597	748	661	
Residual effects of manures applied during 1921–23	774	714	600	674	745	752	860	835	100 lb. N as cake, 400 P_2O_5 as super and 100 K_2O as sulphate
	762	682	540	673	745	691	640	802	100 N + 400 P_2O_5 + 200 K_2O
do	941	744	594	720	753	862	749	784	100 N + 150 P_2O_5 + 200 K_2O
	713	786	682	761	787	834	781	873	50 N + 75 P_2O_5 + 100 K_2O
do	700	736	583	662	807	809	749	814	100 N as nitrolim + 150 P_2O_5 + 200 K_2O
	807	722	640	710	797	724	720	739	100 N as ammonium sulphate +150 P_2O_5 + 200 K_2O

applied. In the residual effect series, this can only be due to the small quantities of cattle manure, leaf and twigs covering, applied annually. The only exception to this is the "residual effect series" of 1927-32 which had received artificials for 3 years only in 1924-26. This seems to indicate that the artificial manures applied had a better effect than the cattle manure.

The object of the whole series of experiments from 1921 to 1936 was to find out an optimum dose of artificial manures that should be added to the generally decreasing quantities of cattle manure usually available and get good crops. The results clearly indicate the possibility of raising the yields from 590 lb. to 786 lb.

Average yields for every treatment during the various periods of experiment and also averages of "manured" and "unmanured" series during every period are given in Table III. Detailed yields for another period, 1933-36, when the whole garden was left unmanured to study residual effects and then start further experiments are also given in Table III.

Only average yields in lb. per acre from all treatments during every period are given below.

1921–23		1924–26		1927–32		1933–36	
Treatment	Yield	Treatment	Yield	Treatment	Yield	Treatment	Yield
Check series	588	Manured	760	Res. effect	638	Res. effect	618
Manured ,,	790	Res. effect	760	Manured	783	,,	726

In the first set of strips, the yield has risen from 588 lb. to 760 lb. and then fallen to 638 lb. during the next six years and further down to 618 lb. in the next period of three years. In the second series of strips which received manure in 1921-23 and also in 1927-32, *i.e.*, during a period of 9 years in all, the fall in yield is only from 790 lb. in 1921-23 to 726 lb. in 1933-36.

The total yields of the farm have also been collected as far as available from published annual reports and are given below.

Year	Yield in lb.	Year	Yield in lb.
1921–22 ..	2720	1929–30 ..	2820
1922–23 ..	2504	1930–31 ..	2918
1923–24 ..	3145	1931–32 ..	3080
1924–25 ..	3092	1932–33 ..	2697
1925–26 ..	2982	1933–34 ..	3737
1926–27 ..	3482	1934–35 ..	2695
1927–28 ..	2310	1935–36 ..	3970
1928–29 ..	2655	1936–37 ..	4149

Table III

Treatment and average yields during various periods of experiments

Period 1921–23		Period 1924–26		Period 1927–32		Period 1933–35	
Treatment	Crop lb. per acre	Treatment	Crop lb. per acre	Treatment	Crop lb. per acre	Treatment	Crop lb. per acre
Check ..	628	Am. sulphate+Potash ..	800	Res. effects ..	603	Res. effects ..	
do ..	518	N+K+Phosphate ..	767	do ..	641	do ..	
do ..	620	Cake+Potash ..	786	do ..	630	do ..	
do ..	588	N+K+Phosphate ..	787	do ..	676	do ..	
Average ..	588		760		638		618
Groundnut cake ..	757	Res. effect ..	774	100 N (cake), 400 P, 100 K ..	714	do ..	674
Cake+Super ..	733	do ..	762	100 N, 400 P, 200 K ..	682	do ..	769
N+P+Potash ..	904	do ..	941	100 N, 150 P, 200 K ..	744	do ..	768
Ammonium sulphate	778	do ..	713	50 N (cake), 75 P, 100 K ..	786	do ..	730
Am. sulphate+Super	760	do ..	700	100 N (Nitrolim), 150 P, 200 K ..	736	do ..	690
N+P+Potash ..	803	do ..	807	100 N (Am. sulphate), 150 P, 200 K ..	722	do ..	725
Average ..	790		783		730		726

The above figures give some idea of variations in yield under actual working conditions. The variations are the combined effects of season, manuring, age and nature of yielding trees, and soil variations as well.

The results have been considered from a purely numerical point of view. It may be worthwhile examining all detailed figures available in records from a statistical point of view.

It has already been stated that a manurial application of 501 lb. N as cake, 75 lb. phosphoric acid as super, and 100 lb. potash as sulphate has given an yield of 786 lb. per acre of 400 bearing trees.

Another important money crop in Kadur and Hassan Districts is coffee. From experiments conducted on the coffee research station from 1929-39, the average yield over a period of 10 years has worked out to 6·5 cwt. or 728 lb. per acre and that too with an annual manuring of 50 N, 75 P and 100 K. Planted at a standard distance of 6′ apart each way, an acre of coffee also contains 1,200 bushes of all ages in course of time. Just how many of these carry crop every year has not been accurately determined. It is a strong coincidence that both crops have given almost identical yields.

During a tour undertaken by me as assistant chemist in 1911-12, twenty-six samples of soils were collected from areca gardens. Of these, 6 were from the Marthur Farm itself, and the rest from various localities as given in Table IV, which give information on some of the chemical constituents determined in course of time according to American AOAC methods. The nitrogen content of the 26 samples analysed varies from 0·03 to 0·22%. Eleven of the samples have a nitrogen content of 0·15% and over, while only two contain 0·2%. Four samples contain between 0·03 and 0·06%. In 10 samples, the nitrogen content varies from 0·12 to 0·14%. Taking localities into consideration, the samples from Koppa, Sollebile and Megarvalli seem to be the poorest. The samples from Agumbe which has the heaviest rainfall in the State are not below the average.

Humus also has been determined in all the samples. In this also there is a wide variation ranging between 0·82 and 2·56%. Here also the samples from Agumbe are not below the average. Generally speaking, samples rich in humus show a good nitrogen content as well.

Phosphoric acid and lime have been estimated in very few samples and consequently cannot be commented upon.

Table IV

Composition of soils from areca gardens

Reg. No.	Locality	Description	Nitrogen %	Humus %	Phosphoric acid %	CaO %
809	Marthur Farm	From plot manured in 1912	0·185	2·56	0·122	0·27
810	do	do	0·120	1·48	Trace	0·13
811	do	do	0·134	1·57	do	..
812	do	From unmanured plot	0·170	2·32	..	..
813	do	From unmanured plot	0·155	2·12	..	..
814	do	From unmanured plot	0·160	2·04		
884	Koppa	From plot manured 3 years ago	0·120	1·41		
885	do	From plot manured 4 years ago	0·050	1·23		
886	Sollebile	From abandoned garden	0·050	1·18		
887	do	From plot manured 3 years ago	0·160	1·75		
888	Agumbe	Ghat Garden	0·140	2·30		
889	do	From plot manured a year ago	0·160	2·94		
890	do	From plot manured 2 years ago	0·134	2·32		
891	Megarvalli	From manured plot a year ago	0·030	0·82		
892	do	do a year ago	0·060	0·84		
893	Vedur	do 4 years ago	0·160	2·35		
894	do	do 6 years ago	0·150	2·33		
895	do	do 1 year ago	0·170	2·50		
896	do	do 3 years ago	0·150	1·97		
897	do	do 2 years ago	0·170	2·50		
898	Hulimane	do 2 years ago	0·220			
899	do	do 3 years ago	0·140			
900	Niscani	do 2 years ago	0·125			
901	do	do 1 year ago	0·120	2·58		
902	Nadhalli	do 2 years ago	0·210	2·60		
903	do	do 2 years ago	0·140	2·25		

If samples are now collected from all representative tracts and analysed by improved modern methods, a lot of useful information can be obtained on an all-India basis.

Summary and Conclusions

The experiments described and discussed above were carried on for a period of 16 years from 1920-21 to 1936-37, divided into 4 periods. During the first two periods of 3 years each, the experiments were meant to give a general idea of the manurial requirements of the areca palm. The quantities of manures applied were 100 lb. of nitrogen, 400 lb. of phosphoric acid and 80 lb. of potash per acre of 400 bearing trees, in addition to a general dose of 10 to 20 lb. of cattle manure per tree and usual leaf-mulch.

In the first period of 3 years, the "cattle manure series" gave an average yield of 590 lb. of cured nuts per acre while the yield from "complete artificial manure series" was 904 lb. or an increase of 52%.

During the second period of 3 years, the "artificial manure series" were left unmanured to study residual effects and the other series was manured with artificials. The yield from "residual effect series" increased from 904 to 941 lb., while the increase in the other series was from 590 to 787 lb. which meant an increase of 34%. Clear indications of the necessity or otherwise of phosphates was not shown.

During the third period of 6 years, the previously manured series was left without manure to study residual effects and the other series was manured with varying doses of N, P and K to find out an optimum dose. It was found that 50 lb. N, 75 lb. of phosphoric acid, and 100 lb. of potash per acre gave the maximum yield of 786 lb. per acre. During the same period, the maximum yield from the residual effects was 676 lb.

During the last period of 4 years, the residual effect yield from the previously manured series was 730 lb. while in the other series the average had come down to 618 lb.

The indications of the whole are that a garden once brought into good yielding condition may be manured once in 3 years and that an yield of over 750 lb. can be obtained by an application of 50 N, 75 P and 100 K using groundnut cake as the source of nitrogen.

Collecting all facts and figures from publications of the Mysore Department of Agriculture, and drawing upon the re-

sources of my memory also, the above account has been written 17 years after my retirement from service. If the present staff engaged on areca research has the time and inclination to ransack the various experimental records in the chemical section, some new facts may come to light and a revision of conclusions drawn may also be necessary. I sincerely trust that this account of work done in the past for over 16 years will be of some use to those engaged on areca research at present. It is a pity that the old Marthur Farm was closed and valuable plant material with a lot of known information about it has been lost.

References

1. *Cultivation and Manuring of the Areca Palm.* By L. C. Coleman and M. K. Venkata Rao.
2. *Journals of the Mysore Agricultural and Experimental Union,* Vol. 5, No. 2, pp. 85-87; and Vol. 9, No. 1, pp. 8-11.
3. *Annual Reports of the Department of Agriculture, Mysore.* (1933-34 to 1936-37.)
4. *Review of Work on the Coffee Research Station, Balehonnur.* Published by the Indian Coffee Board.

(Received 6th January 1955)

A NOTE ON THE LARVAL PARASITES OF THE *LABLAB* POD-BORER (*ADISURA ATKINSONI* MOORE)

By Dr. M. Puttarudriah and G. P. Channa Basavanna*

The lepidopterous pod-borer, *Adisura atkinsoni* Moore, is usually a very serious pest of *Dolichos lablab* (Field bean—*Avare*), occurring year after year and often taking a heavy toll of the crop. The caterpillar bores into the green pods and feeds on the beans within. When it is young, the caterpillar bores into the flower buds and tender pods and feeds on the contents. Thus all stages of the pods, beginning from flowers to mature pods, are attacked, often resulting in heavy reduction in yield of beans in the end. The pest is active in the fields only during the winter months (October-January) when the crop is in flowers and pods, and hibernates in the pupal stage during the other period of the year. The only larval parasite that has so far been recorded on the pest is *Bracon lefroyi* Dudgeon and Gough, which was first definitely reported by Ayyar (1927) in South India, though earlier records of it as *Microbracon* sp. or *Rhogas* sp. ? (Ayyar, 1920; Rao, 1919) may probably refer to the same species. Krishnamurti and Appanna (1948) have reported *Microbracon brevicornis* Wesm. as a larval parasite of the pod-borer, but the photograph [Plate 3, (6)] of the parasite given by them clearly shows that the species has been somehow misidentified and that it appears to be that of *Bracon lefroyi.*

Borer-infested pods collected at different dates during the season from various localities around Bangalore and enclosed in jars revealed that in addition to *Bracon lefroyi,* two ichneumonid parasites, *Hymenobosmina* sp. and *Enicospilus* sp., not so far recorded on this insect, also emerged from the pod-boring larvæ (*A. atkinsoni*). Studies were undertaken to know the incidence of the three species of larval parasites from the beginning up to the end of the season and to investigate the possibility of utilizing these parasites in the biological control of the pod-borer. For the study of the incidence of the parasites from time to time, collections of pods infested with the pod-borer were made throughout November, December and

* Division of Entomology, Mysore State Department of Agriculture.

January during the season of 1953-54 and likewise during 1954-55, and the collections were examined for parasitisation by any of the three parasites. Parasitisation by *B. lefroyi* could be made out easily as the parasitised larvæ were found paralysed and parasite-grubs found feeding on the host-larva, and such larvæ were separated for the emergence of the parasites. In the case of the other two parasites, symptoms of parasitisation were not apparent as the host larvæ were not paralysed and the parasite-grubs were found within the host-larvæ. All the unparalysed larvæ were counted and kept separately in jars with soil at the bottom and with fresh pods as food for the larvæ. The emerging parasites were taken out and counted. During the examinations, varying number of dead larvæ (many of them probably paralysed by *B. lefroyi*) were often found, on which no parasite-eggs or grubs were seen, and such host larvæ were not counted as parasitised. The percentage of incidence of different species of parasites which emerged from the pod-borers collected from various localities around Bangalore during the first week of November, December and January of the two seasons—1953-54 and 1954-55—is given in Table I.

TABLE I

Incidence of larval parasites of Adisura atkinsoni *Moore*

Month and year	No. of larvæ examined	Percentage of larvæ parasitised by			Total percentage of parasitisation	Percentage of larvæ dead due to unknown cause
		B. lefroyi	*Hymenobosmina* sp.	*Enicospilus* sp.		
November, 1953	550	1·5	0·5	Nil	2·0	Nil
December, 1953	480	4·3	3·5	0·3	8·1	1·2
January, 1954 ..	650	32·5	1·8	1·5	36·1	3·5
November, 1954	250	2·0	1·5	Nil	3·5	0·4
December, 1954	320	5·5	2·0	Nil	7·5	6·3
January, 1955 ..	350	38·0	14·0	3·0	55·0	4·3

Bracon lefroyi D. & G. (HYMENOPTERA : BRACONIDÆ)

In these preliminary observations, it is seen that during the first week of November, the total percentage of parasitisation (2·0% and 3·5%) as well as that of the individual species was very low, and increased towards the end of the season, *i.e.*, January, during the first week of which month the total

percentage reached beyond 50 during 1954-55, *B. lefroyi* alone accounting for more than half of this number. It was also seen that the species which was preponderating in number over others in one locality was not necessarily so in another locality at the same time. But towards the end of season (January) *B. lefroyi* was found to be invariably much more in number than either of the other two species in all the localities.

This is an ectophagous parasite of half to full grown caterpillars. Occasionally even earlier stages of the caterpillar are attacked. The host-larva is stung and paralysed by the female parasite while the former is within the *lablab* pod, and eggs are laid on its body. Usually 4-12 parasites emerge out from each parasitised host-larva 10-15 days after egg-laying. The parasite-grubs, though external feeders, prefer to feed in concealed locations, as it is seen that, when pods containing parasite-grubs within are opened, they shun light and recede under some cover. Pupation also takes place inside the infested pods, in whitish cocoons. The adult female was always seen to have attacked borer larvæ within pods.

B. lefroyi has been reported as a larval parasite of a number of insects, the chief amongst them being the spotted and pink boll-worms of cotton which have been attempted to be controlled by using this parasite. Various workers have studied the biology and ecology of this species. Among them Ahmed and Gulam Ullah (1939 and 1941) have studied its ecology in detail. Though Deshpande and Nadkarny (1936) attempted to rear the parasite on a large scale, no satisfactory method has so far been evolved for the mass production of the parasite. As the parasite is observed to increase in number and to exercise a good controlling influence over the pod-borer only towards the end of the *lablab* season in nature, by which time most of the damage has been done to the crop, there is scope for investigating the possibility of introducing the parasite in large numbers in the infested fields at the beginning of the season with a view to control the pest in its initial stages before it multiplies further. A suitable rearing technique, using an alternate laboratory host which in its turn can be reared easily throughout the year, is quite necessary to produce the parasite in large numbers and to maintain cultures in the laboratory for timely releases. This will also facilitate intensive biological and ecological studies of the parasite in relation to its various hosts including cotton boll-worms and investigation of the possibilities of making use of it in the biological control

of these pests-species. Attempts are being made to find out such a laboratory host and evolve a suitable technique for the mass-production of this beneficial parasite.

Hymenobosmina SP. (HYMENOPTERA : ICHNEUMONIDÆ)

The adult parasite is dark brown in colour with the abdomen and legs yellowish brown, and with the female having a conspicuous exerted ovipositor. The parasite-grub develops within the host larva and emerges out of it before pupation, which usually takes place within the infested pod, inside an elongate-oval cocoon covered with greyish brown silk. The pupal case is usually seen with the dry remains of the host-larva attached to a side. Only one grub develops in each pod-borer.

Enicospilus SP. (HYMENOPTERA : ICHNEUMONIDÆ)

This species is usually the least common of the three, and often evident towards the end of the season. The adult is a honey yellow, large wasp with the abdomen arched, and its base being constricted and long. It is very active and feeds on honey when provided. The parasite-grub is an internal feeder and only one parasite develops in each parasitised host-larva. Pupation is outside the host-larva and in a barrel-shaped dark-brown cocoon devoid of silken covering.

The authors are grateful to the Director, Commonwealth Institute of Entomology, London, for the determination of the species of parasites.

REFERENCES

Ahmed, Taskir and Gulam Ullah (1939), *Indian J. Ent.*. 1 (1 & 2), 17-47.
——— and ——— (1941), *Ibid.*, 3 (2), 245-84.

Ayyar, T. V. Ramakrishna (1920), *Rep. Proc. Third Ent. Meeting, Pusa*, p. 933.

Deshpande, B. P. and Nadkarny, N. T. (1936), *Imp. Coun. Agric. Res.*, *Sci. Monograph No.* 10, pp. 50-61.

Krishnamurti, B. and Appanna, M. (1948), *Agric. Coll. and Res. Inst.*, *Bangalore, Ent. Ser. Bull., No.* 13.

Rao. Y. Ramachandra (1919), *Agric. Res. Inst., Pusa, Bull. No.* 89, pp. 61.

(Received 10th February 1955)

THE MERITS OF THE JAPANESE METHOD OF PADDY CULTIVATION COMPARED WITH LOCAL METHODS UNDER MYSORE CONDITIONS

By Dr. S. V. Govindarajan[1] and H. G. Gopala Rao[2]

During the past two years or so, public attention in India has been focussed on the method of paddy cultivation, popularly referred to as the Japanese Method of Paddy Cultivation. Great hopes have been placed on this method for increasing the per acre yield of paddy and solving the rice deficit in the country. The method has also been hailed as showing the way for increased production of other crops through intensive manuring and other improved practices.

While great publicity has been given to the various procedures and practices involved in this method, the relative benefit of these techniques over the prevailing practices, and as to their suitability to differing and different soil and climatic types had been largely unproven. The early trials conducted in parts of Bombay State had shown the method as being capable of producing larger yields than the prevalent local practices and, on this basis, the method had come to be popularised as being advantageous throughout the country. Simultaneously with the large-scale popularization of the techniques involved in these new methods, it was felt that an assessment of the merits of this method by comparing with the local methods of manuring and cultivation was necessary and to this end the Indian Council of Agricultural Research sponsored a scheme during 1953 and continued it during 1954 also, for conduct of these comparative trials in different parts of India under varying soil, climatic and irrigation conditions. The scheme provided for the grant of free fertilizers and a subsidy of Rs. 25 per *ryot* to compensate them for the expenses and the extra trouble undertaken by them in co-operating with the scheme and laying out the trials as per our requirements.

The following localities were selected as representing typical and differing conditions of cultivation of paddy and in each

---

[1] Agricultural Chemist, Mysore State Department of Agriculture.

[2] Assistant Chemist, Mysore State Department of Agriculture.

locality 5 *ryots* selected at random were requested to co-operate in the conduct of these trials.

Locality, Cultivation Conditions for Paddy, Nature of Soil, etc.

1. Mandya.—Channel-irrigated, newer channels, *maidan** area, red sandy and gravelly soils.
2. Malavalli.—Channel-irrigated, newer channels, *maidan* area and red sandy soils.
3. T. Narasipur.—Channel irrigation, older channels, *maidan* area. Dark-grey, silty and loamy soils.
4. Hiriyur.—Channel irrigation under V. V. Sagar, *maidan* area. Brown clay soils, calcareous, alkaline.
5. Amruthur.—Tank-fed. Marconahalli Tank. Red soils.
6. Shimoga and Anandapuram.—*Malnad.*† Heavy rainfall zone. Grey sandy loam, acid soils.
7. Bhadravathi.—*Malnad.* Medium rainfall type. Channel-irrigated. Brown, sandy, acid soils.
8. Budikote.—*Maidan.* Low rainfall zone. Tank irrigation. Red, sandy, loam soils.

In all, forty experiments were laid out with following five treatments in each experiment, all the treatments being randomised.

Treatment A.—Ryots' method of manuring and cultivation. This was a variable practice according to the locality. Some *ryots* applied only bulk manures, while others applied some artificial fertilizers also.

Treatment B.—Manuring as recommended by the Mysore Agricultural Department, the method of cultivation, raising nursery, transplantation, etc., being according to the local methods. This treatment included application of 3,000 lb. of green manure applied at puddling time, followed by 112 lb. groundnut oilcake and 40 lb. of ammonium sulphate at planting time and a further 75 lb. of ammonium sulphate at first weeding.

Treatment C.—Manuring as recommended by the I.C.A.R. with the local method of cultivation. This treatment involved manuring with 6,000 lb. of green manure

---

* Open areas.

† Hilly (*Ghat*) areas.

applied at puddling, followed by 200 lb. of ammonium sulphate and 200 lb. of superphosphate applied at transplanting time.

Treatment D.—Manuring as recommended in the Japanese method, with the method of cultivation and planting being according to local practices. For manuring 6,000 lb. of green manure were applied at puddling, 100 lb. of ammonium sulphate and 100 lb. of superphosphate applied at planting and an additional dose of 100 lb. of ammonium sulphate and 100 lb. of superphosphate applied one month after transplantation.

Treatment E.—The method of raising nursery, transplantation, cultivation and manuring are all as recommended for the Japanese method of cultivation.

The raised seed-bed nursery was adopted in the case of Treatment E only while the local type of nurseries were raised in the other cases. Row planting of the seedlings and 10" apart was adopted in Treatment E only while the local practices were adopted in the first four treatments. The various manurial doses mentioned above are per acre.

The crops from the various experiments were harvested during the months of December 1953 and January 1954 according to the locality. Of the eight centres selected, the results from one centre, *viz.*, Bhadravathi, were vitiated owing to wrong methods of data collection and hence the same were rejected. The summary of the yields of grain and of straw, and the statistical interpretations are given in the table below.

Statistical analysis of the experimental data show that the Japanese method of cultivation and manuring (Treatment E) has given significantly higher yields of grain and straw over the *ryot's* method in four centres, *viz.*, Mandya, Malavalli, T. Narasipur and Budikote. The increases have ranged from 692 lb. to 1,829 lb. of grain per acre (approximately 3½-10 *pallas* per acre) and 1,288 lb. to 2,201 lb. of dry straw per acre.

With manuring at higher levels only, according to the dosage for the Japanese method, keeping the nursery and cultural operations same as per local practices (Treatment D), there was significantly higher yields of grain over the *ryot's* method in the three centres, *viz.*, Malavalli, T. Narasipur and Budikote. The increases in yield have ranged from 476 lb. to 2,090 lb. of grain per acre (2½-11 *pallas* of paddy approximately). Signifi-

Table I

Calculated yields of grains and of straw in lb. per acre under different treatments at the different centres

Sl. No.	Centre		Treatments A	B	C	D	E	Critical difference at 5% in lb. per acre	Effect of treatment in descending order
1	Mandya ..	Grain	3979·2	3980·8	4074·4	471·2	4671·2	± 562·22	E D C B A
		Straw	7889·6	8736·0	9312·0	10866·4	9891·2	±1439·9	D E C B A
2	Malavalli ..	Grain	3803·0	4638·0	5394·0	5585·0	5632·0	± 920·4	E D C B A
		Straw	4838·0	5999·0	6651·0	6409·0	6126·0	±1228·1	C D E B A
3	T. Narasipur ..	Grain	3335·4	4122·6	3966·4	5425·7	4699·1	±1035·2	D E B C A
		Straw	5400·2	7325·1	8265·8	10060·1	8701·3	±1548·7	D E C B A
4	Shimoga and Anandapuram ..	Grain	4026·4	4901·6	4667·6	4287·2	4526·8	± 668·2	B C A E D
		Straw	6544·8	5964·8	6620·0	6279·2	7252·8	±1244·02	E C A D B
5	Hiriyur ..	Grain	3816·0	3901·6	3629·6	3382·4	4312·8	± 603·78	B A C E D
		Straw	6815·2	7006·4	6626·4	6504·8	5949·6	± 770·8	B A C D E
6	Amruthur ..	Grain	1400·0	1405·0	1579·0	1655·0	1321·0	± 452·4	D C B A E
		Straw	2208·0	2604·0	2144·0	2446·0	2443·0	±1077·3	B D E B A
7	Budikote ..	Grain	2533·5	2942·3	2780·5	3010·4	3363·8	± 352·9	E D B C A
		Straw	4232·4	5288·4	4317·6	5109·6	5739·8	± 977·6	E B D C A

cantly higher yields of straw over the *ryot's* method have been obtained in four centres, *viz.*, Mandya, Malavalli, T. Narasipur and Budikote, the increase ranging from 877 to 4,459 lb. per acre.

When the manures were applied in one dose at transplanting as per Treatment C, significantly higher yields of grain were obtained at Malavalli and significantly higher yields of straw at Malavalli, Mandya and T. Narasipur. When the manuring was done as per the recommendation of the Agricultural Department, significantly higher yield of grain over the *ryot's* method was obtained in Budikote and significantly higher yield of straw in T. Narasipur and Budikote.

The results further show that none of the treatments had any significant effect on yield of grain and straw in the experiments conducted at Hiriyur, Anandapuram, Shimoga and Amruthur.

These experiments are being repeated on paddy under this scheme during the current year also and the results and the conclusions to be drawn therefrom would help to substantiate the inferences drawn from the experiments described here.

(Received 15th September 1954)

A NOTE ON THE RESULTS OF EXPERIMENTS WITH SYSTEMIC INSECTICIDES

By Dr. M. Puttarudriah*

Systemic insecticides have been said to render plants "to bite back"; in other words, to kill the insects which feed on them. They have captured the imagination of the entomologists and are fast becoming popular in plant protection in America and other Western countries. Though the systemics were known as early as 1925, their popularity has been growing from 1951. The significant feature in them is their absorption and translocation through the sap in different parts of the plant; and its selective killing of the insects that feed on such parts and not the beneficial predators and parasites.

The systemic insecticides are organic phosphorous and fluorine compounds, synthesised by Dr. Schrader of I. G. Farben Bayer, Liverkusen in Germany during the Second World War. They were later studied and tested in England and America. Of the several systemic insecticides, Pestox and Systox are said to be most promising and extensively studied.

To test the utility of some of these systemics in Mysore, free samples of Pestox 3 H—a scarlet red liquid containing dimethylamides of polyphosphoric acids equivalent to 66% bis dimethylamino phosphorous anhydride (Schradan) with a wetting agent; and Isopestox, a white crystalline odourless powder containing bis isopropylamin fluorophosphine oxide were received from Messrs. Pest Control Ltd. of Cambridge, England; and tested on a small scale in the laboratory.

Small plots, $3' \times 3'$ of groundnut, cowpea, ragi (*Eleusine*), cotton and brinjal were laid and allowed to get naturally infected by aphids, thrips and mites; advantage was taken of aphids heavily infecting *Kachi* (*Solanum nigrum*) and *Gliricidia* plants and mealy bugs infecting cotton, brinjal and *Thevitia* in the laboratory compound for testing these insecticides. The formulations used in spraying were 4 pints of Pestox 3 H in 100 gallons of water; and 2 lb. of Isopestox in 100 gallons of water, which worked out to be 0·41% and 0·20% respectively. Foliage spraying, soil treatment and seeds soaking in the insecticides and planting were carried out at the same

* Government Entomologist, Mysore State Department of Agriculture,

strengths. For soil treatment, the dosage used for each plot or plant, was five times the quantity required for foliage spray. Three repetitions were made in each case, untreated infected plots or plants being maintained for control. The results of these tests with both the systemics are tabulated below :

TABLE I

Name of insect	Host plant	% Mortality	Time in hours	Remarks
Aphis laburni Kalt. ..	Groundnut	100	24	
Aphis rumi is Linn. ..	Gowpea	100	24	
do	*Gliri idia*	100	24	
Aphis gossypii Gloven ..	*Kachi* (*Solanum nigrum*) L.	100	24	
do	Brinjal	100	24	
do	Cotton	100	24	
Aphis maidis Fitch. ..	Ragi	100	24	
Tæni thrips longistylus Karny ..	Groundnut	100	24	
Ecacanthothrips steinskyi (Schmutz)	Cotton	100	24	
Tetranychus Sp. ..	Cotton	100	24	
do	Brinjal	100	24	
Pseudcoccus lilacinus Ckll. ..	Cotton	nil	72	Later observations discontinued
do	*Thevitia*	nil	72	
Phenococcus insolitus Green ..	Brinjal	nil	72	

Pestox 3 H was found to be very effective on aphids, thrips and mites on all the host-plants tested ; in a few hours some aphids were dropped dead, while others were dead and stuck up on the plants. A satisfactory wipe out of these sucking insects could be seen in about 24 hr. The residual action of Pestox 3 H lasted for nearly a month, during which time none of these insects could be seen on the treated plants. After about a month, there was a slight building up of aphids at the tender parts of the tested plants, particularly if they happened to be very close to untreated infected plants.

Experiments with Isopestox yielded similar results, but the lasting effect could be only for about a week.

Seeds of groundnut, cowpea, radish, soyabean, mustard, greengram and Bengalgram respectively were soaked in Pestox 3 H solution at the strength used for spraying and soil treatment, for 24 hr., and sown in plots of $3' \times 3'$ for each. Seeds soaked in water only for 24 hr. were also sown in a similar plot for control. The germination was normal and good in all cases. No aphids, thrips or mites could be seen on any of these plants for nearly a month. Since the control plot also had very little infection by aphids, etc., no conclusive observation was

possible. After a month the plants became infected by flea beetles, sawflies and mildew. These experiments are being pursued.

Pestox 3 H and Isopestox, both were very effective when sprayed and also when the soil was treated around the bases of plants, the former being quicker in both cases than soil treatment, in killing pests.

These tests together with other systemics like Systox are being carried out.

Though the systemic insecticides are very promising and useful, their toxic hazards to plants and their products, animals and man, effect on soil and compatibility with other insecticides, etc., are all to be fully ascertained, before they can be put into the hands of the common cultivator. At present, care is necessary in protecting oneself against touching, breathing and spraying against the wind, etc., of these insecticides. The method of application like seed-soaking before planting is to be perfected, when it will be easy to handle and economical to use.

(Received 28th February 1955)

DAHLIA

By M. R. Anandaramiah*

Dahlia no doubt is one of the prettiest flowers which should not be absent from any garden. It is suitable to any position in a garden and its cultivation is very simple and easy. There is a great diversity of form and size in the flower, exceptional range of colour, the habit of plant varying from 1′ to 8′ in height and possessing a continuous blooming period longer than most of the garden flowering plants. For mass effect in borders, for cultivation in large beds, for culture in pots, for garden decoration and for cut flowers, there are few other plants to surpass the Dahlia. Dahlias were said to have created an interest as a possible food plant and were at one time cultivated in France for their tubers which were used in the same way as potatoes. They have a bitter flavour however and so have gone out of favour.

Structure

Dahlia is a Mexican herbaceous plant. Sometimes it is woody at the base. Stems are branching, at least at the base. Leaves are opposite, pinnate to 3-pinnate. The flower-heads are long-stalked, carrying both the disc florets and ray florets. The roots are tuberous which store the nourishment needed for the production of the stems and flowers. These tuberous roots are connected to a condensed crown bearing a number of buds.

History

History reveals that dahlia was first discovered in Mexico as far back as 1575 by Fransisca Hernandez. In 1789, it was introduced into Europe when Vicente Cervantes, Director of the Botanic Gardens, Mexico, sent seeds or roots to the Abbé Cavanilles, Director of the Royal Botanic Garden at Madrid. It was in 1791 that Cavanilles described and named it as dahlia after Dr. Andreas Dahl, a noted Swedish Botanist. Altogether, he described three forms and named them as *Dahlia pinnata* because of its pinnate or winged leaves with double purple flowers, *D. rosea* with single rose flowers and *D. coccinea* with single red flowers. All these three forms were sent to Kew in 1798

* Curator, Govt. Botanic Gardens, Lalbaugh, Bangalore.

from Madrid through the agency of Marchioness of Bute. But these were soon lost and the uninterrupted cultivation of dahlia in England dated from 1804, when a parcel of seeds was sent from Spain by Lady Holland. Cavanilles also sent seeds of his three varieties to various botanic gardens.

Classification

The three varieties of Cavanilles' formed the parents of all the garden and show varieties until the introduction of the cactus flower and more modern groups. At the present, a number of varieties has been raised, particularly in France, England, Germany, Holland and America,† partly by purposeful crossing and partly as chance seedlings and the number is annually increasing. But a vast majority of the dahlias grown are variations which have arisen in cultivation from the species originally introduced or derived from hybrids between a few of them. Such clonal varieties which do not come true from seeds are thousands in number and large number of named forms are in cultivation at the present time. A horticultural classification of these forms adopted by the National Dahlia Society of England and the Royal Horticultural Society is as follows :

Class IX
Cactus Dahlia

Class X
Semi Cactus Dahlia

Class XI
Star Dahlia

Class I. SINGLE DAHLIAS

In 1880, Florists' Singles were raised and introduced in Britain, the parent presumably being *D. coccinea.*

† In Mysore also quite a large number of new varieties have been raised but they have remained unnamed and unregistered.—*Ed*

(*a*) *Show Singles.*—Flower-heads not exceeding 3″ across, the 8 (only) rays smooth, somewhat recurved at tips, broad, overlapping to form a perfectly round flower.

(*b*) *Singles.*—Flower-heads with rays not so completely overlapping as in (*a*), the tips separated. Ex. *Pequot Yellow, Purity.*

(*c*) *Mignon Dahlias.*—Flower-heads as in (*b*) but plants not exceeding 18″ in height. Ex. *Coltness Gem, Torquay Gem.*

Class II. ANEMONE-FLOWERED DAHLIAS

These were evolved in 1829. Flower-heads with one or more series of flat ray florets surrounding a dense group of tubular florets longer than the disc florets in Class I and usually of a different colour from the rays. Ex. *Goix du Ind. Robifor.*

Class Ia
Show Single Dahlia

Class Ib
Single Dahlia

Class II
Anemone Flowered Dahlia

Class III
Collarette Dahlia

Class IV
Paeony Flowered Dahlia

Class V
Formal Decorative Dahlia

Class VI
Informal Decorative Dahlia

Class VII
Show Dahlia

Class VIII
Pompon Dahlia

Class III. COLLARETTE DAHLIAS Ex. *Sparkler, Tribune*

Early in this century, these were raised in France and Germany. Flower-heads with one or more series of flat ray florets

as in Class I and above each series a ring of florets (the collarette) only half the length of the rays and usually of a different colour.

(*a*) *Collarette Singles.*—Flower-heads with a single series of rays and one collarette with a yellow disk.

(*b*) *Collarette Pæony-flowered.*—Flower-heads with 2 or 3 series of rays and collars and a yellow disk.

(*c*) *Collarette Decorative.*—Similar to (*b*) but fully double.

CLASS IV. PÆONY-FLOWERED DAHLIAS Ex. *Susan Cœ, The U.S.A.*

These were raised in Holland. Flower-heads with 2 or 3 series of ray florets and a central disk.

(*a*) *Large Pæony-flowered.*—Flower-heads over 7" across.

(*b*) *Medium Pæony-flowered.*—Flower-heads from 5-7" across.

(*c*) *Dwarf Pæony-flowered.*—Plants not exceeding 30" in height.

CLASS V. FORMAL DECORATIVE DAHLIAS Ex. *Commando, Five Star General, Jeresy Beauty*

Flower-heads fully double, showing no disk. All florets regularly arranged, their margins usually sightly incurved, flattened towards tips which may be broadly pointed or rounded.

Four subclasses *a, b, c* and *d* corresponding with those under Class IV.

CLASS VI. INFORMAL DECORATIVE DAHLIAS Ex. *Jane Cowl, Joan Fernes*

Flower-heads fully double, showing no disk, rays not regularly arranged, broad, more or less flat or slightly twisted, more or less acutely pointed.

Four subclasses *a, b, c* and *d* corresponding with those under Class IV.

CLASS VII. SHOW DAHLIAS

Flower-heads fully double, over 3" across, almost globular with central florets like the outer but smaller. Florets with

margins incurved, tubular or cup-shaped, short and blunt at mouth.

Fancy dahlias form a subclass here with florets tipped white or striped.

CLASS VIII. POMPON DAHLIAS Ex. *Atom, Betty, Malone, Ila, Johnny*

They were first raised in Germany in 1850. Flower-heads similar to those in Class VII but smaller. For show purposes the flower-heads must not exceed 2" across.

CLASS IX. CACTUS DAHLIAS Ex. *Growing Glory, Goulburn, Miss Ohio Marionette, Miss Belgium, Zenith*

In 1879, Henry Cannel of England exhibited *D. Juarezii*—the first cactus dahlia bloom, which caused quite a sensation. This became a parent for hundreds of types of dahlias.

Flower-heads fully double, margins of flowers revolute for not less than three-quarters of their length, the central florets forming a filbert-shaped group.

(*a*) *Large-flowered Cactus.*—Flower-heads over 4½" across.

(*b*) *Small-flowered Cactus.*—Flower-heads not over 4½" across.

(*c*) *Dwarf Cactus.*—Plants not exceeding 30" in height.

CLASS X. SEMI-CACTUS DAHLIAS Ex. *Amelia Earheart, Edith Wilkie*

Flower-heads fully double, florets broad at the base, their margins revolute towards tip, slightly twisted for about half their length.

Three subclasses *a*, *b* and *c* corresponding with those in Class IX.

CLASS XI. STAR DAHLIAS

These were raised early in this century. Flower-heads small with 2 or 3 series of somewhat pointed rays, not or scarcely overlapping at their base more or less recurving margins, forming a cup-shaped flower-head with a disk.

Propagation

Dahlias, although require very little skill in their cultivation, propagation is not generally very well understood. The plants are increased or propagated in several ways, *viz.*, (1) seed, (2) cuttings, (3) grafting, and (4) division of tubers.

Propagation by Seed.—Most seedsmen offer seeds of various types. Seeds do not keep true to types as they will be the result of crosses brought about by insects that visit these flowers, the flowers themselves being self-sterile. On the other hand, if the object is to secure new types, propagation by seed may be attempted and after selecting the desired type, the same may be multiplied by vegetative means. In foreign countries, it is seen that trade growers and a few amateurs raise thousands of plants annually in the ceaseless quest for novelties. Even in Bangalore, several *malis* like Sri. Munivenkatappa and nurserymen like M/s. M. Ramiah & Sons are successful in raising many novel and beautiful decorative dahlias. Seeds are sown in October in the plains and from March to July in medium to high elevations. If sown about the time for planting bulbs, the seedlings produce strong and vigorous plants producing flowers in 3 months. The method of raising plants is identical with those for most of the hardy annuals.

Propagation of Cuttings.—The easiest, cheapest and quickest method of increasing dahlias is by rooting cuttings of the stem. When a large number of cuttings are required, dormant healthy tubers are planted in a bed closely packed and surrounded with a light soil mixture such as old potting material. The tops of the tubers are left exposed. No water should be administered until the tubers begin to throw out shoots. Some varieties shoot out very freely while others are shy. Some tubers produce shoots in close clusters while others singly, from the eyes near the top. The cuttings may be taken off when about 3″ in length, each provided with a terminal bud and 3 to 4 sets of leaves. With the help of a sharp knife, cut just below the bottom node and remove the bottom pair of leaves. Then insert them without delay 1″ deep, either singly or several round the edge of a seed pan or a pot filled with a compost containing 4 parts of well decayed and sifted leaf-mould, 3 parts of well decayed cowdung, 3 parts of sand and 2 parts of red earth. After insertion they are watered and left in a shady place. A light watering may be given every evening

on dry days. The cuttings root in about 3 weeks and afterwards, they are repotted. Further they develop small bulbs, which go to rest after the growing period. They grow bigger and bear larger flowers during the next growing season.

Propagation by Grafting.—This is not a common practice of propagation. In case of some varieties, they do not produce tubers very freely and therefore, in order to preserve them, grafting is sometimes resorted to. The object of grafting is that any spare tubers without growing eyes may be used as the 'stock' on which cuttings are grafted. These single tubers are potted singly into 4" or 6" pots leaving sufficient of the tuber exposed on which to graft the cutting of any variety desired. Cleft grafting is the system employed and tying in must be done with care, using wide strands of raffia. Under satisfactory conditions, the union takes place within 3 to 4 weeks. Then the plants must be kept growing slowly and afterwards cuttings should be taken and rooted as described above.

Propagation by Tubers.—Division of tubers is the simplest way of increasing the stock and this is usually practised at the planting time. In this method the number of plants obtainable is limited. Buds are not produced on the tubers themselves and for each division care must be taken that a piece of the old stem bearing a bud is taken with each tuber. This is readily done if the old root is allowed to sprout before division is attempted. Generally the time for planting is indicated by swelling of the buds on the crown to which the tubers are attached. The roots are kept in moist sand and sprinkled with water. When buds have grown about ½", the clumps are divided in such a way that each part has a growing bud in it.

Cultivation

Dahlias are simple and easy of cultivation. It presents few problems and is of a routine character. They can be grown anywhere except the hottest places. A moderated degree of rainfall during its growing and blooming period and a mild climate with comparatively humid atmosphere contributes to best results. Dahlias as a rule love sun, light and open situations. As such plants grown in partially shaded or enclosed positions are apt to grow taller than the normal height of the variety with fewer flowers. Protection against wind is very essential.

Dahlias can be cultivated both in pots and in beds. While cultivating in pots, choose 12" or 14" pot according to the habit

of growth of the particular variety—the more vigorous varieties requiring larger pots. After arranging the drainage materials in the pot, fill it with a little more than half with a compost consisting of 2 parts of red earth, 2 parts of sand, 2 parts of leaf-mould, 2 parts of manure, 1 part of loam and ¼ part of charcoal. After dividing the tubers, a piece of the old stem bearing a bud with the tuber is taken and placed in the centre of the pot, putting some sand underneath the tubers. Cover the tubers an inch deep with the compost. Water heavily immediately after planting and continue to water sparingly until the shoots emerge out. Protect the pots against wind and keep them in open sunny situation. As it grows fill up the pot to about ½" from the top with the soil covering the new shoots at the base. With the object of inducing branching, nip off the growing shoot when it has grown 6 to 9". Keep only three shoots that come up. As the stems of dahlias are very slender at this stage when they have grown about 1' high stake them intelligently. As the growth progresses, water them liberally—say twice a day on sunny days. Dahlias are gross feeders and when they begin to produce buds feed the plants with liquid manure prepared from oilcakes, once in 10 days normally. Blooms appear 40 to 45 days after the shoots are pinched. Usually buds come up in threes. For exhibition purposes remove the side buds and retain only the central bud and if it is only for garden decorative purposes all the buds may be retained. The flowering period lasts for 1½ to 2 months. After the flowering period is over, gradually lessen the water until all the leaves and shoots die down. Later cut back the stems to the ground level and store them in a dark, cool place in shade. This is how dahlias are grown in Lalbagh for exhibition purposes.

Dahlias can be grown in the ground in much the same way as in pots. With regard to the soil, dahlias certainly enjoy a deeply dug medium of sandy loam but it is true that it will grow in almost any soil. After digging about 1½' to 2' deep, expose the clods to the sun for some time and afterwards bring the soil to a fine tilth. Incorporate enough of well decayed cowdung, leaf-mould and lime. For garden displays dahlias are often given too much of space. This should mainly be governed by the type of soil. Strong decorative and cactus types will require 4'. Small decorative and pæony-flowered collarettes and star types 2½' to 3' and the bedding types 1½' to 2'. The effect desired is generally a mass of bloom and this can

be obtained by close planting. Either tubers or healthy plants may be planted. In case of planting the plants, they should be shaded from the direct sun and well watered about a week. When the plants are well established the shade may be removed. When the plants are growing, due to overweight, they may fall over. Hence stalking has to be done nicely to keep the plant erect and firm. If one stake is insufficient, 3 stakes may be driven in a triangular form to support the whole plant. Nothing is more objectionable in a garden than to see a forest of stakes. Good staking, apart from keeping the plant erect and firm, should be completely hidden or inconspicuous when the plants have developed. As in the case of pot culture, when the plants are about to come into bloom, liquid manure has to be applied. Besides, one or two applications of artificial manure may also be given. A suitable mixture would be bonemeal, superphosphate and sulphate of potash of 4 oz., 2 oz. and 2 oz. respectively to the square yard. For large blooms for exhibition purposes a weak application of blood manure may be given.

The removal of faded flowers every morning is one of the essential things that should not be neglected as their continued presence not only gives the collection an ugly appearance but also causes them to terminate the flowering season prematurely.

However, to obtain the best results, perfect drainage, well manured sandy loam, open sunny situation, shelter from high winds, freedom from the roots of large trees and shrubs and plenty of water are essential.

Pests and Diseases

Dahlias are attacked by very few insect pests and fungus diseases. Aphis is a common pest which weakens the vegetative shoots. This can be controlled by any insecticide like *Hongey* oil soap, tobacco decoction or FOLIDOL E 605 at 0·035% strength. Mealy bugs may appear on the stems which can be controlled effectively by a spray of FOLIDOL. Sometimes beetles are found attacking the foliage and eating. This can be prevented by spraying with any stomach poisons like FOLIDOL or lead arsenate solution. At certain times mildew is also found on the shoots which can be controlled by dusting with flowers of sulphur or spraying with SOLBAR or any copper fungicide like CUPRAVIT, etc.

Storing Dahlia Bulbs

When the flowering period is over, cut the shoots 6" above ground. Clumps may be allowed to remain in the soil for

another week. Then lift them carefully Place clumps stem-side down. Dry in an airy shade until soil shakes off freely. Cut off fine and depleted roots. Cut stems back again within 3″ from the crown. If there is warmth, cover the clumps with peat moss or sand. Dust them with flowers of sulphur as a preventive against mildew, etc. It is better to store the clumps in boxes of sand, coal ashes or sawdust.

When the clumps are intended for the pot wherein they were cultivated, the procedure would be to invert the pots for a few days after stopping water and then to cut off the shoots. Further the same pots may be kept as such in a cool room.

References

"Dahlias at Wisley, 1938", *R.H.S. Journal*, LXIV, Part 3, March 1939, p. 139.

A. J. Cobb, F.R.H.S., "Dahlias", *R.H.S. Journal*, LXIV, Part 5, May 1939, p. 214.

D. M. A. Jayaweera, B.Sc. (Lond.), "Propagation of Dahlias", *The Tropical Agriculturist*, Vol. CII, No. 2, April-Jhne 1946.

F. J. Chittenden (1951), *R.H.S. Dictionary of Gardening*, Vol. II, (Clarendon Press), Oxford.

THE HAZARDS OF MODERN INSECTICIDES

By Dr. M. Puttarudriah and B. M. Maheswariah*

In the field of plant protection, many new synthetic organic insecticides—chlorinated hydrocarbons and phosphorous compounds are being employed to fight the insect menace. As their importance to public health and for increasing the world food supply become more apparent, the use of new chemicals to control insects will continue to increase.

The introduction of any new insecticide poses necessary questions regarding its toxicity to man, other animals and beneficial insects. The hazard, if any, attached to the new material requires to be examined from two major points of view. These are the question of the safety of the farmer or operator who is to handle the new chemical, and the question of the hazard to the health of the individual who consumes the crop in one form or the other. The latter involves the question of residues, if any, and the determination of these residues. We can expect almost any insecticide to cause death under conditions of gross carelessness in handling or applying them. Cole (1953) opines that today, proper precautions must be taken with any new insecticide and its use should be regarded as involving a hazard until the contrary is proved.

Every insecticide should undergo thorough examination by toxicologists so that we will know how toxic it is to man and animals. Careless handling, indiscriminate use and lack of proper knowledge of these insecticides have resulted in poisoning on many occasions. Instances are not wanting in this respect. Srivastava (1952) quotes from various workers that so far, in various parts of the world, about 140 poisoning cases by DDT and 200 by organo-phosphates have been recorded. DDT, Parathion, TEPP, Chlordane and Sodium mono-fluoroacetate have caused 14, 22, 9, 1 and 13 deaths respectively. Spiotta (1951) reports a detailed history of a case of Aldrin poisoning and comments that from the observations in that case it would appear that a dose of 25·6 mg. of Aldrin per kilogram of body weight produces completely reversible changes in the nervous and renal systems. Cole (1953) reports that there have been, in fact, following the use of Aldrin and Dieldrin fewer than

* Division of Entomology, Mysore State Department of Agriculture.

20 *bona fide* cases of illness reported and most of these have been the result of accidental or in some cases intentional ingestion.

Princi (1952) states that research has produced the information that not only the central nervous system but also the liver and kidneys may be affected when adequate quantities of certain chlorinated hydrocarbon insecticides are absorbed. Smaller quantities which will produce physiological effects without serious illness are usually absorbed either through accidental ingestion or because of careless handling and poor personal hygiene. Records show that illness has occurred following attempts to clean spray nozzles by sucking, by failure to remove material which had spilled on the clothes or body and while formulating mixture of the insecticide by hand.

According to Srivastava (1952) the greatest hazard of insecticides, particularly DDT, lies in the use of food materials and milk of animals sprayed with DDT or fed on DDT-treated fodder. DDT has been detected in the milk of cows which have been either fed on pure DDT mixed with fodder or DDT-treated materials. Cows, when sprayed with DDT emulsion, or when their barns have been treated, have shown the presence of DDT in their milk. It is surprising to find that DDT has been detected even in the milk of women. Cattle fed on DDT-contaminated hay showed DDT in the meat even after cooking ; and, eggs from hens fed with DDT-contaminated food showed a heavy amount of DDT. DDT has been found in the fat and pork of hogs treated with DDT, which remained even after cooking.

West and Campbell (1950) note that according to Cameron the pure *gamma*-isomer of benzene hexachloride is more toxic than DDT, to warm-blooded animals. When symptoms of poisoning appear, the end is usually in sight and little can be done to save the animal. Hough and Mason (1951) reported that in U.S.A., without adequate experimental background, growers used considerable quantities of BHC on fruits and vegetables in 1947 with the result that some products, particularly potatoes and tomatoes, developed an off-flavour after processing.

Normal doses of either DDT or BHC, when cautiously used, do not produce abnormal results. It has been investigated and found that the threshold of DDT and BHC is 7 p.p.m. and 15 p.p.m. respectively in foodgrains. According to McClintock and Fisher (1949), DDT 4 parts per million on corn fed to sheep and cattle for four years produced no effects. The U.S. Public

Health Service holds that dust concentrations up to 10% DDT applied to clothing in eradication of lice offer no serious health hazard. They further quote the following statement of Dr. Rodney R. Beard, Stanford University School of Medicine, about DDT, "While present knowledge suggests that danger of being made sick by slight contacts with the poison is not great, and that persons who have casual exposures are in no serious danger, nevertheless, those who work with it frequently, or use it in the mouth, or inhaling the dust or spray should be very cautious." After careful study on the effects of sprays and dips of DDT and other persistent insecticides, Bushland *et al.* (1950) hold that the spraying of dairy barns with DDT or TDE for fly control resulted in milk contamination unless special precautions were taken.

The phosphorous compounds may be absorbed rapidly through the skin and cause deleterious effects. Frequent exposures greatly increase the danger of absorbing toxic amounts. They present more or less of a residue hazard depending on their toxicity and speed of weathering. They may accumulate in the body or they may have a cumulative injurious effect. The pest control operators and the general public are being repeatedly and strongly warned against careless handling at all stages and the indiscriminate use of these materials. According to Hough and Mason (1950), parathion is extremely dangerous if swallowed, inhaled or absorbed through the skin. They further warn that no one should handle the spray or dust materials unless all precautions are strictly followed. Srivastava (1952) reported that in California, a very experienced and well trained senior laboratory assistant, Mr. Hugas, died on 23rd August 1949, from parathion poisoning. In Brazil 14 persons died from parathion poisoning in the spring of 1950 and in U.K. 2 persons handling parathion in the 1950 spraying season, developed symptoms of poisoning of moderate severity.

Care needs to be exercised in displacing the "balance of nature" as unexpected results sometimes follow after the application of the pesticides. Many of these modern insecticides are very toxic to parasites, predators and productive insects like bees which perform pollinating service. According to West and Campbell (1950) Potter and Perkins treated *brassica* crops with DDT formulations and on examination of the treated plants found numerous dead parasitic Hymenoptera caught in the bases of leaves. Many of the specimens found were of the genus *Aphidius*, which are parasitic on aphids. Dead ladybird

beetles were seen on some of the treated plots. Eckert (1945) observed that the increased use of insecticides and particularly of poisonous dusts has killed off a majority of our wild insect pollinators and has resulted in the death of a number of honey bees annually. In view of the great importance of maintaining an adequate bee population for pollination, Eckert (1945) suggests that DDT and other chemicals should be applied in the minimum quantities necessary to control the given pest ; and not applied at all to plants in full bloom ; and to apply the insecticides when the bees will not be actively working—either early mornings or late in the evenings.

These new organics should be used with great care around pools and streams since they are highly toxic to fish and other organisms which live in water.

To control some chewing insects that attack crops, poison baits prepared out of these pesticides are used, where spraying, dusting or fumigating are not practicable. Some of these deadly poison baits prove fatal to chickens, birds and animals attracted to them.

Nevertheless, the agriculturists should not be frightened away from these chemicals because of these hazards ; but before using them they should become familiar with their properties in order to handle them competently. A proper understanding of the action and potentialities of these insecticides will make it possible to protect man both from insects and the chemicals which are used to control them. The risks should be considered in relation to their potential usefulness. The authorities in U.S.A. issued instructions to stop the application of parathion when a few cases of poisoning were reported ; but on thorough investigations it was found that the poisoning was due to careless handling without adequate protection and that in view of its great advantages it can be used strictly following certain safety measures.

Many of the old insecticides like arsenates and cyanides, etc., though more hazardous than modern pesticides to man and animals are still being used and recommended with warnings, on account of their high insecticidal value and usefulness. The superiority of most of the new organics to the older insecticides lies in their effectiveness not only as stomach and contact poisons but also as residual contact poisons that kill many species of insects by means of a slow paralysis after their tarsi have contacted the residues. In addition to being stomach and contact

poisons some of them have considerable fumigating action particularly in enclosed places. The new organic insecticides show a higher degree of safety on most plant species at the recommended dosages. These new chemicals, if used correctly, are valuable weapons in the war against insect pests. So, one need not be much concerned about the hazards of these insecticides. With adequate precautions and better knowledge of their exact performance, they can be utilised in pest control to a great advantage. In view of the accidental hazards, it is also felt that more intensive investigations as to the required minimum quantity of each insecticide to control a particular pest and the proper time of application with necessary precautions under Indian conditions are very necessary.

References

Bushland, R. C., Claborn, H. V., Beckman, H. F., Radcleff, R. D. and Wells, R. W. (1950), "Contamination of Meat and Milk by Chlorinated Hydrocarbon Insecticides used for Livestock Pest Control", *J. econ. Ent.*, **43** (5), 649-52.

Cole, L. W. Leyland (1953), "Aldrin and Dieldrin, Part I", *World Crops*, **5** (6), 7.

Eckert, J. E. (1945), "The Eyect of DDT on Honey Bees", *J. econ. Ent.*, **38** (3), 369.

——— (1945), "The Avoidance of Bee Poisoning", *Proceedings of the Washington State Horticultural Association, Fortieth Annual Meeting.*

Hough, Walter S. and Mason, A. Freeman (1951), *Spraying, Dusting and Fumigation of Plants.* (Macmillan, New York), pp. 762.

McClintock, J. A. and Fisher, Wayne B. (1949), *Spray Chemicals and Application Equipment.* (Horticultural Press, LaGrange, Indiana), pp. 320.

Princi, Frank (1952), "Human Toxicity of Certain Chlorinated Hydrocarbon Insecticides", *Third International Congress of Phytopharmacy, Paris* (Sept. 1952), 7.

Spiotta, Lieutenant Eugene (1951), "Aldrin Poisoning in Man", *A.M.A. Archives of Industrial Hygiene and Occupational Medicine* (Dec. 1951), 560-66.

Srivastava, A. S. (1952), "Fatal Cases of Poisoning connected with the Application of Modern Synthetic Insecticides particularly during Field Use", *Indian J. Ent.*, **14** (3), 299-301.

West, T. F. and Campbell, G. A. (1950), *D.D.T. and Newer Persistent Insecticides.* (Chapman & Hall, London), 632.

(Received 14th September 1954)

POTATO CULTIVATION IN CHIKBALLAPUR AREA

By K. Ranganatha Rao, L.Ag.*

Seasons

Potato in general thrives best at an elevation of 3,000′ and requires cool and equable temperature. It is only in the cold weather months from November to March that conditions conducive for average growth of the crop are obtained. A maximum of 80° F. is ideal for good tuber production in most of the cultivated areas, though the crop can tolerate upto 90° F. These conditions being satisfied in this area, a fair crop of potato under irrigation is raised in winter, which occupies an area of nearly 2,000 acres. There are two other seasons of raising potatoes, *i.e.*, from May to August and from September to December. The area in these seasons is much less, since other crops have to be maintained during this period.

Soil

Heavy soils are not suited for potato cultivation. The soils of this area vary from red loam to sandy loam and could be easily worked besides allowing free and full development of tubers. The soil takes up good irrigation and provides good drainage. Potatoes as a rule will not flourish in alkaline soils and thrive best in slightly acid soils. Neutral soils, which form the bulk of this area, are heavily manured with organic compounds and provide suitable soil conditions for raising a fair crop of potato. Lands where potatoes are raised are kept in a fine condition with uniform level, fertility of the soil being kept up with continuous manuring and other operations.

Irrigation

Assured supply of water for irrigation as often as needed is an essential condition for a winter crop of potatoes. This problem has been solved by tapping the subsoil water at a very high cost. Though most of the wells have been provided with electric power, lift irrigation by means of *mhotes* is also in practice. The area commanded under each well depends upon the availability of water. The usual extent of crop raised

* Agricultural Inspector, Chikballapur.

under each well by means of electric power is about 2 acres with a 3 to 5 H.P. pump ; whereas an extent of 1 acre can be maintained by means of *mhotes* under each well.

Seeds

Prior to World War II, potatoes were imported from Italy, Sicily, Malta and Rangoon. Since these markets are lost, potatoes from different parts of the country were tried. Out of many varieties tried, *Simla* variety of seeds gave good results and were suitable for this climate and soil. Thirty thousand bags (each weighing 2 railway maunds) are annually transported from Simla for seed purposes and planted during December and January, which is the main crop of this area.

Potatoes lifted from winter crop are used as seed material for planting in May and June after storing for a period of 2 months. Sixty % of the total production of winter crop is used as seed material in Hassan District for planting in the early monsoon.

Seeds raised from monsoon crop in this area out of seed material obtained by winter crop, is again used as seed material for planting in September.

The seed material required for December planting is usually got from Simla as continuous planting of seed material will result in poorer yields.

Apart from *Simla* variety of seed material, *Rangoon, Dharwar* and mountain varieties imported before war have been retained and used as seed material in different seasons. The practice of introduction of seeds from different places within the locality and change of soil has given better yields.

Simla variety of seed potato weighs about 3 to 5 oz. on an average and will have 6 to 8 eye-buds per tuber. Each tuber is cut into 4 to 8 setts depending upon the number of eye-buds and each sett is allowed to have one or two eye-buds.

Preparation of Land

The main winter crop of potato is raised after a crop of onion which occupies the land from May to October. The land is left fallow for a period of 1½ to 2 months. Raising a green manure crop of sunhemp in between the crops and incorporating in the soil before planting potato is also in practice. The

land is dug to a depth of 1 to 1½'. Nutgrass[1] and *hariali*[2] grass which are the common weeds, are collected while digging. Deep digging is often given when these weeds are persistent. Lands dug are allowed to dry for a period of a fortnight and then clods are broken by wooden mallets and the soil turned to a depth of 6" to 8". Bunds at a distance of 13' are put up. Farmyard manure or night soil compost is spread over the land at the rate of 20 to 40 cartloads per acre. Potato responds very well to heavy manuring. As such, organic manure is applied to the best advantage and to the individual's capacity. Superphosphate at the rate of 1 cwt. and oilcake at the rate of 4 cwt. is applied to the land. Parry's Potato Fertiliser which is being used by progressige agriculturists in the area has given good results. The mixture is applied at the rate of ½ ton per acre before planting in furrows with a basal dose of 10 tons of organic manure either as farmyard manure or green manure. The results of such application are much appreciated since the mixtures have normally increased the yield and also improved the keeping quality. The land is then splash-irrigated and the manure is mixed in the soil. Another light stirring of the soil is done after mixing the manure. The land is then levelled by means of hand rakes. Furrows at a distance of 1' are opened between the bunds to a depth of 6". Subsidiary irrigation channels to feed two furrows on either side of the irrigation channel are opened, so as to give uniform water-supply to the furrows and to check wastage and excessive irrigation.

Planting

The seed potatoes used are of *Simla* variety and usually the selected tubers are planted. *Numbri, Ratian* and *Bengal pool* are some of the *Simla* varieties. *Numbri* is the usual variety which is used in these parts. *Numbri* is planted extensively and is suited to this track. The seed potato is cut into 4 to 8 setts. At this rate 8 to 10 bags weighing 2 railway maunds each, are required for planting an acre. The setts are planted at a distance of 6" apart within the furrows and pressed to a depth of 1" or 2". Irrigation is usually given the next day, depending upon the moisture contents of the soil. Irrigation once in 4 days is given till sprouting is completed. The sprouting will be complete by about the end of the third week, after planting.

---

[1] *Cyperus rotundus* ತುಂಗೆಹುಲ್ಲು (ಕೊನ್ನಾರಿ)

[2] *Cynodon dactylon* (ಗರಿಕೆಹುಲ್ಲು)

Irrigation and Earthing Up

Irrigation is given once in 4 days up to the time of earthing up. When the crop is about a month old earthing up is given. If oilcake and superphosphate is applied before planting, no manure is given at the time of earthing up. Otherwise groundnut oilcake at the rate of 4 cwt. is given. Irrigation once in 3 days is continued till the crop is $2\frac{1}{2}$ months old and thereafter irrigation once in four days is given till the crop is picked. The crop is usually irrigated a day before picking. The formation of small tubercles at the end of the underground stems are visible only after 50 days from planting. Thereafter the development is rapid and in another 6 weeks their full size is reached.

Harvesting

The crop will be ready for harvesting after 3 months from the time of planting. When the crop attains the stage of maturity, the leaves begin to turn yellow and dry up and eventually die down, which is a sign that tubers are ready for lifting. Lifting is carefully done to avoid damage to tubers by cutting. Lifted tubers are heaped in the field itself in small quantities. When the lifting is completed, the entire quantity of tubers is removed to an elevated place and heaped, care being taken to remove the damaged and cut tubers from the heap. The heap is covered with dried potato haulms. Covering the heaps with sugarcane leaves, and grass is also in practice in some parts of this area. A bund of 9″ width is formed round about the heap so that rain-water may not enter the heaps. Between the heaps a space of 3′ is allowed to facilitate movement. Bamboo mats are finally covered over these heaps. The heaps are left as such in the field for a period of $1\frac{1}{2}$ to 2 months till the produce is finally marketed. The skin of the tubers being very tender, will get spoiled if it is not carefully handled. The skin gets hardened in the heap after a fortnight and facilitates easy handling of tubers.

Heaps are dusted with 5% DDT as a preventive measure against potato tuber moth.

Pests and Diseases

The pests and diseases for winter crop are much less than the crop raised in other seaons. There will not be usually any disease in seeds since the seed material is obtained from the

cold regions of Himachal Pradesh. The common seed-borne disease is ring disease. The disease-free setts are planted. Since the seed material is obtained every year from cold hilly parts of the country the diseases are naturally controlled to a considerable extent. The only serious pest on potato is Epilachna beetle, which is controlled by spraying calcium arsenate with lime and jaggery. Most of the cultivators take up spraying with the assistance of the Department soon after the symptoms of pest attack is noticed. Spraying with FOLIDOL E 605 100 c.c. in 50 gallons has given very good results.

Marketing

Seed material annually received from Simla is 30,000 bags of 2 railway maunds each. Out of this quantity, Chikballapur area consumes 20,000 bags and commands 2,000 acres under this crop every winter season. The total production of this crop is estimated to be 30,000 cartloads of 12 railway maunds. The potatoes were being exported to Colombo, Rangoon, etc., apart from the internal demand from Madras and Calcutta markets. Now that foreign markets are lost, the main marketing centres for the produce are Madras and Calcutta. Out of the total production, 60% of the crop is consumed in Hassan and Chikmagalur Districts, for seed purposes for planting in early monsoon.

The heaps are disturbed and graded, spoiled ones and diseased ones being removed from the heap. Small tubers are also removed before marketing. Graded ones are bagged in standard weights either of 100 lb. or 5 local md. according to the needs of different markets.

Improvements Suggested

The fertility of soil is kept up by continuous manuring and other cultural practices. Heavy soils where potato is cultivated is mixed with sand and red earth to improve the soil suitable for tuber development.

An acre of average potato crop is estimated to consume about 47 lb. of nitrogen, 22 lb. of phosphoric acid and 77 lb. of potash. It is best to compound a mixture of both organic and chemical manures on this basis. The following formulation is recommended for plains as the optimum per acre.

300 lb. of groundnut oilcake, 150 lb. of ammonium sulphate to supply about 54 lb. of nitrogen. 150 lb. of superphosphate

(18%) to supply about 30 lb. of phosphoric acid and 100 lb. of potassium sulphate to supply about 50 lb. of potash.

Since the soils of this area are well stocked with reserves of potash this compound may be limited to two-thirds of its requirement.

The crop being a short-duration one, it is best to apply all the manures in the required dosage before planting. Whatever be the combination of chemical manures applied, the importance of application of sufficient organic manure cannot be ignored, as potatoes respond very well to heavy manuring. Application of wool waste and waste products of tannery which is in practice in some parts of Kolar and Bangalore Districts, has given good results.

Raising a green manure crop and incorporating in the soil—preferably sunnhemp, maintains the fertility of the soil besides increasing the yield. When a green manure crop is raised, the basal dose of compost or organic manure could be reduced.

Yield of potato crop in general is reduced to a considerable extent by pests and diseases. Though there are measures, the *ryots* do not take to spraying and other control measures unless the disease or pest is severe. If preventive measures of spraying are taken, much of the losses can be reduced. To prevent diseases from seed material, the seeds should be pretreated with fungicides and sulphur compounds. It is an important aspect to plant disease-free tubers to have a good crop.

Much havoc is done to tubers in storage. Preventive dusting with DDT before storing is essential.

The crop occupies a large extent in the State and requires detailed study of various aspects in an experimental station. The problem of getting seeds from a very long distance at a high cost has to be prevented. Production of our own seed material suitable for the tract will solve much of the difficulty and reduce the cost of cultivation.

It is essential that marketing facilities are to be created in the interest of the cultivator besides providing credit facilities for seed and manure, which takes away a major portion of the cost of production. It is beneficial if co-operative institutions take up this portion of work in the interest of cultivators.

TABLE I

Cost of cultivation of potatoes at Chikballapur area

Sl. No	Details of operation	Men	Women	Qty.	Rate	Amount
1	Deep digging up to 1′	50	..	..	1 0 0	50 0 0
2	Malleting clods	10	..	..	1 0 0	10 0 0
3	Cost of manure	..	..	20 cart-loads	10 0 0	200 0 0
4	Carting manure @ Rs. 3/- per cart per day for 5 days	5	..	..	3 0 0	15 0 0
5	Preparing bunds ; mixing manure, levelling and turning the soil	25	..	..	1 0 0	25 0 0
6	Opening irrigation channels and splash irrigating	3	..	..	1 0 0	3 0 0
7	Furrowing for planting	6	..	..	1 0 0	6 0 0
8	Cost of seed potatoes	..	..	10 bags	50 0 0	500 0 0
9	Cutting setts and planting	10	10	..	F 0 10 0 M 1 0 0	16 4 0
10	Current charges for irrigation 30 irrigations–3 months	..	..	..	Rs. 11/- a month	33 0 0
11	Irrigations 30 @ 2 men per day	60	..	..	1 0 0	60 0 0
12	Earthing up and weeding	25	..	..	1 0 0	25 0 0
13	Cost of ½ ton groundnut cake and 2 cwt. of superphosphate	..	..	..	..	150 0 0
14	Lifting potatoes	25	..	..	1 0 0	25 0 0
15	Heaping, etc.	..	15	..	0 10 0	9 6 0
16	Feeding labour during planting and lifting operations	..	..	..	..	50 0 0
17	Potato selection and grading while marketing, etc.	..	..	..	..	22 6 0
	TOTAL ..	219	25	..	..	1,200 0 0
	Average yield per acre			600 local mds.	@ Rs. 3/-	1,800 0 0
	Profit, exclusive of assessment, interest on capital and depreciation on machinery (Profits vary according to fluctuations in market rates)					600 0 0

If cultivation is taken up by lift irrigation by means of *Mhote*, the cost of cultivation will exceed Rs. 100 and profits vary proportionately.

(Received 23rd August 1954)

CORRESPONDENCE

A Virus-like Disease of Some Economic Plants in Mysore

VIRUS-LIKE symptoms have been observed for the first time in Mysore State simultaneously on cotton, *Gossypium herbaceum* L. (Malvaceæ), brinjal, *Solanum melongena* L. (Solanaceæ), papaya, *Carica papaya* L. (Caricaceæ) and a daincha variety, *Sesbania paludosa* Prain (Leguminosæ). All the different affected plants were within a few yards of each other, and among them cotton, particularly *hirsutum*, was the worst affected. The earliest symptoms appeared as an inward rolling of the margins, particularly the tips, of the youngest leaves followed by the curling up of the entire leaf-blade upward along the midrib together with a distinct clearing of the smaller veins, which were thicker than normal and gave a rough appearance to the underside of the leaf. The acute symptoms appeared later and consisted of the deepening of the lobes of the leaves along the main veins giving the leaves a dissected appearance with almost complete reduction of the lamina and curling of the marginal edges upwards or downwards like a frill, associated with chlorosis.

Virus diseases of cotton, *bhendi*, brinjal, chillies, tomato and papaya are known in India,[3] but the presence of the same symptoms in the different plants belonging to four separate families is very striking and strongly suggests the existence of one or the same group of viruses transmitted by a common agency. Transmission tests are in progress, including trials with the aphids, mealybugs, jassids, thrips and mites, which are found on the affected plants, since sucking insects are the most important vectors of virus diseases of plants, including cotton.[1,2] Should these tests prove insect transmission, the control of the disease could be achieved by effectively checking the insect vectors.

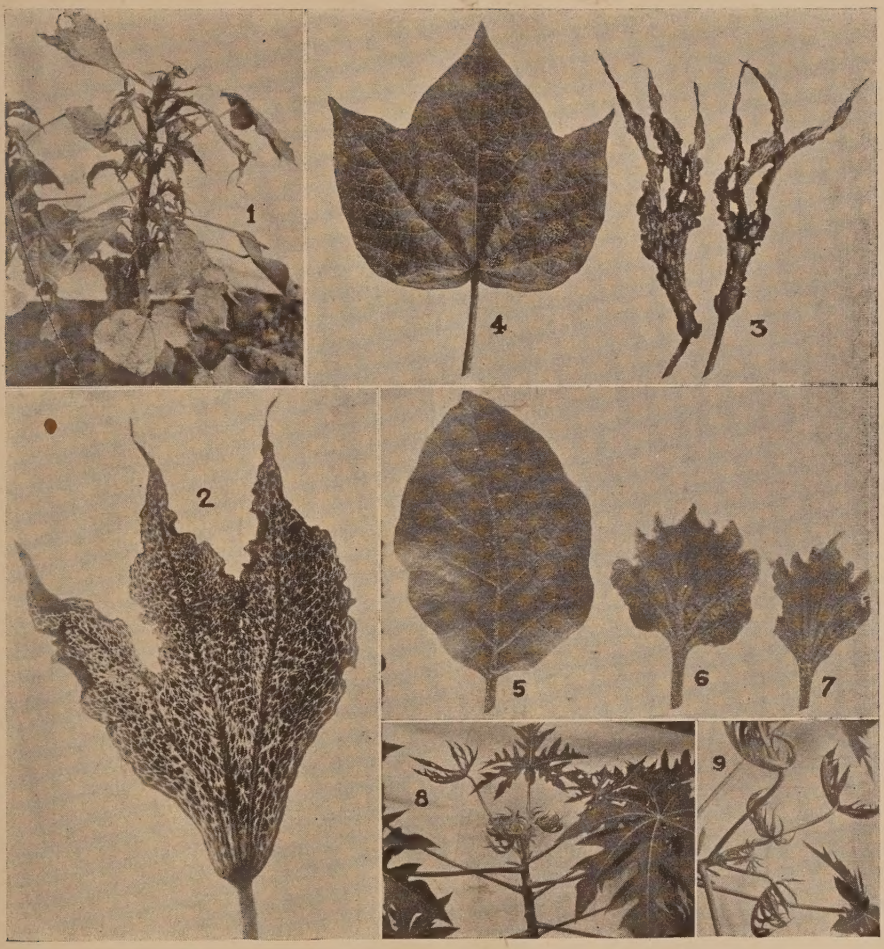
Thanks are due to Sri. P. R. Raghuram Pillay, Artist, for the photographs.

Division of Entomology,
Dept. of Agriculture,
Bangalore-1, *January* 10, 1955.

M. PUTTARUDRIAH.
S. USMAN.

1. Kirkpatrik, T. W. (1930), *Bull ent. Res.*, 21, 127-37.
2. ——— (1931), *Ibid.*, 22, 323-63.
3. Mundkur, B. B. (1949), *Fungi and Plant Diseases.* (Macmillan & Co., Ltd., London.) P. 222.

356-56 Printed at The Bangalore Press, Bangalore City, by C. Vasudeva Rao, Superintendent, edited by M. L. N. Iyengar and published by Secretary, Mysore Agricultural and Experimental Union, Bangalore City.



1. Virus affected cotton plant.
2. Virus affected cotton leaf showing deepening of lobes and chlorotic spots.
3. Same in acute form.
4. Healthy cotton leaf.
5. Healthy brinjal leaf.
6. & 7. Virus affected brinjal leaves.
8. & 9. Virus affected papaya plant.